TECHNOLOGY DEPARTMENT
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1933

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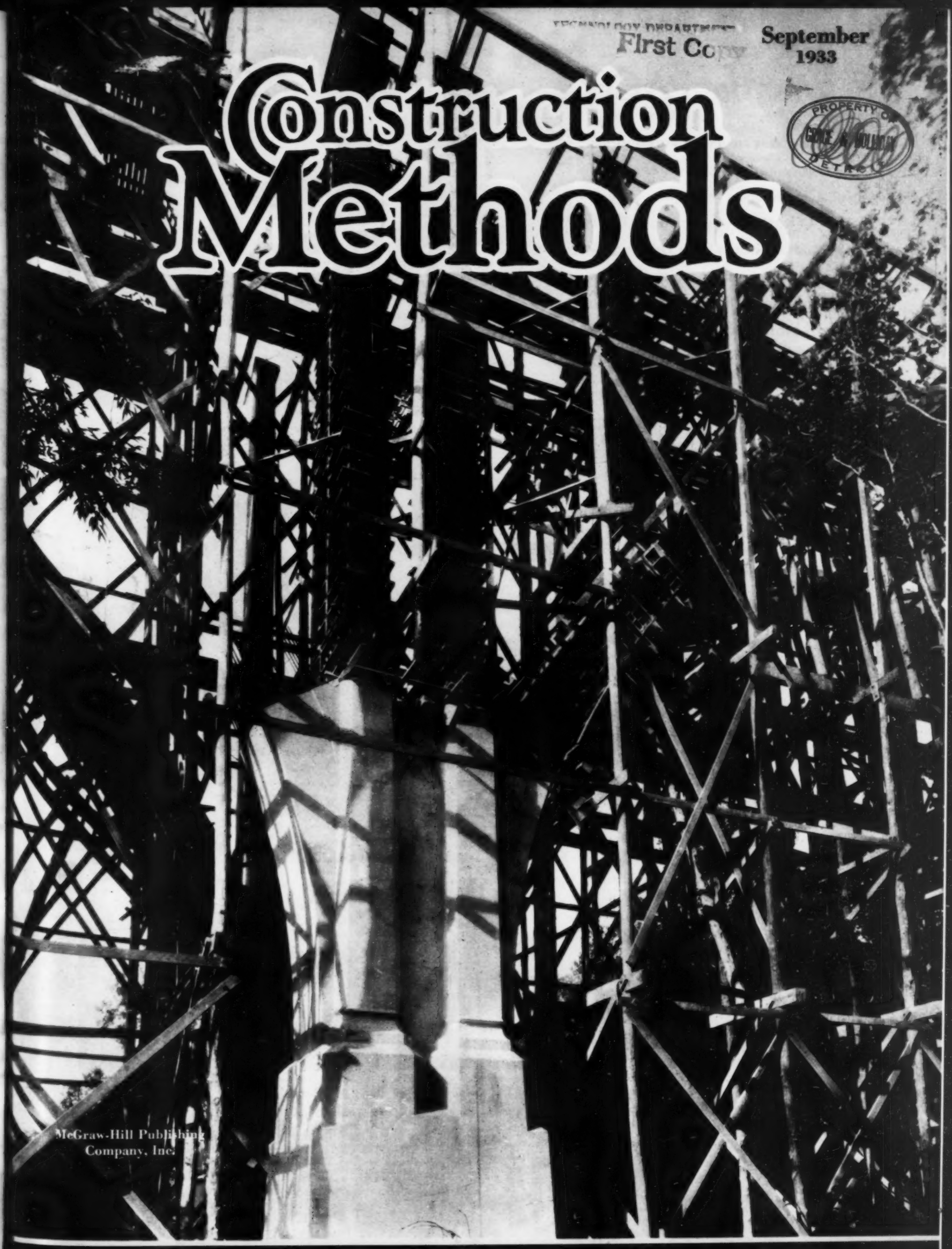
Construction Methods



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Illinois road jobs need the power and speed of the "L" to move dirt at a profit.

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TECHNOLOGY DEPT

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Construction Methods

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Construction Code Hearings This Month

● Action on the master code of fair competition for the construction industry, drafted under the leadership of the Construction League of the United States and submitted to the National Recovery Administration, is expected this month, following public hearings at Washington before Deputy Administrator Malcolm Muir. While changes may be made in the text of the tentative code, published in the August number of *Construction Methods*, it is believed, in the interest of expediting the public works program now under way, that agreement should be reached quickly on the broad principles covering maximum hours of work, minimum wages for labor, and a ban on the practice of bid peddling.

Minimum Wages on Public Works

● Since the construction code was submitted to the N.R.A., however, an important development affecting wages has occurred in the form of an agreement on minimum wage rates on all government-financed construction between the Public Works Administration and representatives of the American Federation of Labor. The Federal Public Works Board, late last month, adopted a plan dividing the United States into three zones, Southern, Central and Northern, and fixed for a period of 12 months the following minimum hourly wage rates for both skilled and unskilled labor:

Southern Zone: Skilled labor $1.00; unskilled, $0.40 (S. C., Ga., Fla., Ark., Ala., Miss., La., Ariz., Okla., Tex., N. M.)

Central Zone: Skilled labor $1.10 unskilled, $0.45 (Del., Md., Va., Tenn., Colo., Utah., Calif., N C., W. Va., Ky., Mo., Kan., Nev., D. of C.)

Northern Zone: Skilled labor, 1.20; unskilled, $0.50 (Me., N. H., Mass., R. I., Conn., N. Y., N. J., Ind., Wis., Minn., Neb., Wyo., Ore., S. D., Idaho, Pa., Ohio, Mich., Ill., Ia., N. D., Mont., Wash.)

Accompanying the announcement of the foregoing minimum rates is the provisio that wage rates existing April 30, 1933, under collective agreements between organized labor and employers shall prevail if the latter are higher than those prescribed in the Public Works Board's recently established schedule.

Effect on Private Construction

● Because of its effect on private construction and, ultimately, upon the market for construction, the minimum wage agreement entered into by the Federal Public Works Board with organized labor has a significance extending far beyond the limits of the public works program. At this writing it is not known whether organized labor will insist that the minimum wage rates paid on construction financed by federal public works funds be incorporated in a code of fair competition for the construction industry, but M. J. McDonough, president of the Building Trades Council of the American Federation of Labor stated that "we anticipate no worse condition from private contractors than we would from the government."

Ray, in The Kansas City Star

Give Him the Works!

TO the exclusion of almost everything else during the last two months American industry has been preoccupied with discussing, drafting and submitting at Washington codes of fair competition under the provisions of Title 1 of the National Industrial Recovery Act. Important as it is, the code feature of the act is only one of its two component parts. The other, Title 2, provides for a nation-wide program of federal, state and local public works construction, involving a total expenditure of $3,300,000,000 and designed as an *emergency* measure to put people back to work *quickly* and enable them, as the President has emphasized, "to buy more of the products of farm and factory and start our business at a living rate again."

The public works program, logically the first stage of the emergency job, has lagged behind the industrial control measures. Initial organization and policy difficulties delayed the start of construction on a large scale. Now, happily, construction is beginning to make headway. Contracts are being let, particularly for state road building, and a start has been made in approving loans for municipal projects which should constitute a major part of the program. Nevertheless, unemployment still perches, vulture-like, upon the homes of millions of able-bodied, but jobless Americans. No scattering fire of buckshot from toy air rifles will dislodge this sinister bird. He must be given the "works". It's now the zero hour for a barrage from the big guns of a nation-wide public works program.

Rates for Highway Labor

● It is still an officially open question whether the minimum wage rates specified by the Public Works Board will apply to highway contracts under the $400,000,000 grant provided in the National Recovery Act. In well informed circles the belief is that state highway departments may elect to adopt such rates but that they will not be required to do so. The Recovery Act, it will be recalled, specifically provides that the state highway departments shall fix pre-determined minimum rates for both skilled and unskilled labor on road work.

Board of Labor Review

● All issues arising under the operation of Public Works Administration contracts are to be heard and decided by a newly created Board of Labor Review consisting of three members, appointed by the President, to represent labor, contractors and the Public Works Administration. The new minimum wage rates, Public Works Administrator Ickes states, should bring about a stabilized condition in the construction industry. Contractors bidding on public projects will know in advance what their labor costs will be. The rates are intended to afford workers engaged in construction on hours limited by code agreements an income sufficient for the maintenance of a decent standard of living.

Code for Engineers

● Under the leadership of the American Society of Civil Engineers one of the most important of the so-called supplemental codes of fair competition to mesh in with the proposed NRA all-inclusive master code for the construction industry is the one which has been drafted to apply to engineers. An important feature of the proposed code is the clear line of demarcation it draws between "professional engineers" and "engineering assistants". The former include state-licensed engineers and those with qualifications for membership in societies requiring 7 years of active practice, with one year in responsible charge of work. The latter are defined as those performing duties of a sub-professional nature, not licensed, and not eligible under the 7-years-of-practice qualification. Minimum wage rates and maximum hours of work for these engineering assistants are proposed, with the right to organize and deal collectively with employers.

Give That Eagle Both of His Wings

MANY observers are concerned over the progress of the public works construction project. This does not imply that progress has not been made but rather that it has dealt almost wholly with matters of organization and administration. Now, we are assured, the organization period is behind us and we may expect the dirt to fly.

Neither does it imply that no progress has been made in actually awarding contracts. Recent reports show a heartening upturn in construction volume, some of which must be credited to the public works program. During July the weekly average of all contracts for engineering construction, public and private, was about $12,600,000; during the week ending Aug. 31 it reached $19,000,000. During July highway awards alone averaged $2,700,000 weekly; during the week ending Aug. 31 they reached $8,592,000. This indicates real progress.

But unless the award of public works contracts is stepped up rapidly and substantially the Public Works Administration will fall pathetically short of "doing its part", without which the National Recovery Act cannot possibly realize the President's New Deal.

N R A Objectives

The NRA effort to raise wages and create more jobs is designed to put more money into the pockets of more people who can buy more goods. Fair enough! But most of this new purchasing power will go for consumer goods, i. e., food, clothing, automobiles and other commodities that are bought for personal use. Moreover, the cost of producing these commodities will be greater, thereby requiring the producer to raise his prices or to forego his profits. If, however, a fair balance be maintained between purchasing power and prices we may expect a gradual growth of trade and employment **among those engaged in producing and handling consumer goods.**

But that is not enough. Let us never forget that in this country no general or lasting prosperity can be based on the consumer industries alone. It is estimated that 35 to 40 per cent of all our workers are employed in producing the materials, equipment and services that are used in construction and other forms of capital investment. And it is in this group that we find the heaviest unemployment and loss of purchasing power. Until this condition has been remedied we cannot possibly have a general increase of buying power sufficient to sustain the demand for consumer goods and eventually to enable business to make a profit in the face of higher production costs.

We are aware that NRA proposes to provide also for higher wages and shorter hours in these producer industries. But of what avail are higher wage scales and shorter hours if there be no demand for the worker's product? These industries are not governed by the same factors that control demand for consumer goods. Demand for producer goods is not immediately responsive to an increase in individual incomes, needs and buying. Eventually, yes; but a substantial lag is inevitable. **Until there is a renewed demand for the product of these workers they can add nothing to the general purchasing power, however much the codes may boost wage rates or reduce working hours.**

If we had decided to rely on the normal recovery of these vast industries we should have to wait until an accumulation of business profits and savings from those otherwise employed, together with an aroused spirit of confidence, could provide the stimulus and the wherewithal for a resumption of private enterprise and investment.

A Two-Part Program

But those who formulated the recovery policy knew better than to try that. Wisely they laid down a two-part program. Through NRA they sought to recreate immediate purchasing power and employment for the consumer industries; through the public works program they sought to stimulate directly and promptly the producer industries, involving so many workers. Thus we might shorten the normal lag and speed the day when private enterprise could resume its program of capital investment.

This was the program. If now we permit the public works section to fall behind the other, we cannot possibly realize it.

We urge upon the administration, therefore, these vital requirements:

1 From now on have the public works program prosecuted more courageously and more vigorously as the one certain source of early employment for those normally employed in the capital goods industries.

2 In approving codes for these industries give due consideration to the fact that higher wage scales and shorter working days cannot, under present conditions, insure an increase of employment or purchasing power. Capital costs, thus increased, are more likely to retard than to stimulate a resumption of private investment and thereby result in diminished demand, employment and purchasing power.

Unless this difference between the conditions that govern demand in the consumer and producer fields be recognized and unless the Public Works Administration do its intended part in stimulating demand for capital goods and services on a large scale, General Johnson's blue eagle, shy one of its wings, never can take off on the flight that promises so much for the American People.

Willard Chevalier

Publishing Director

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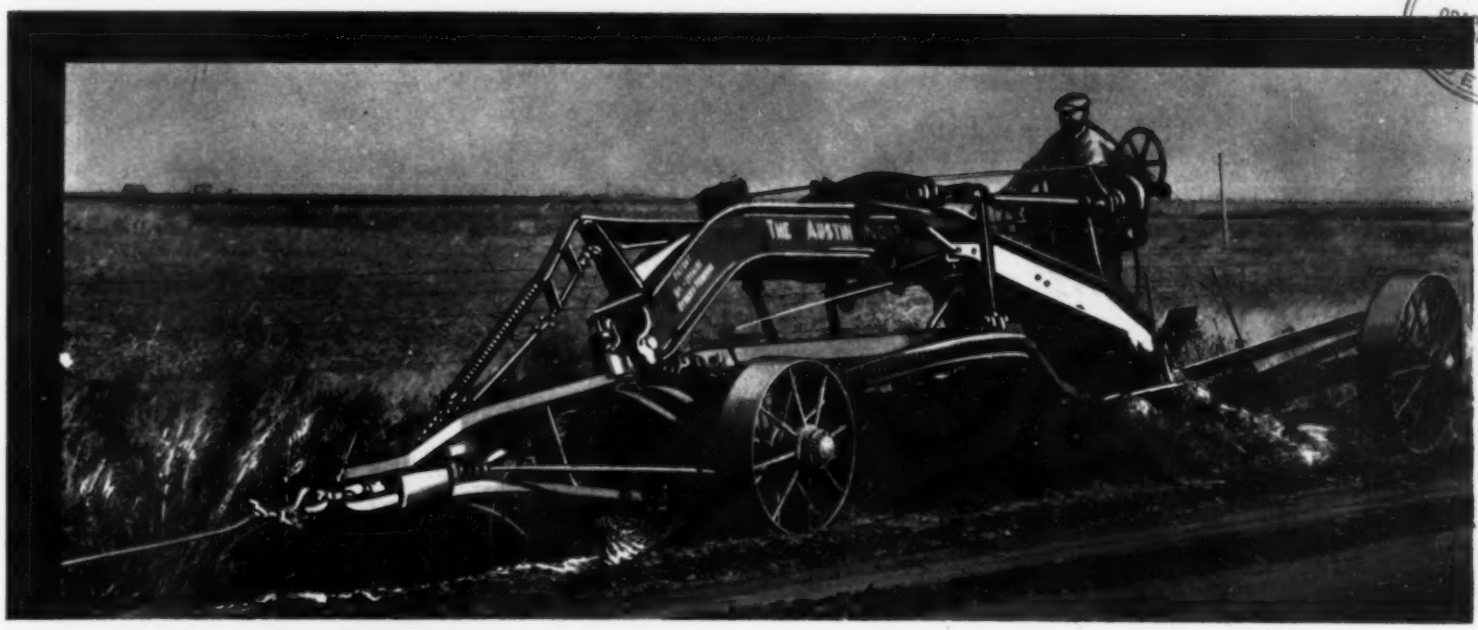

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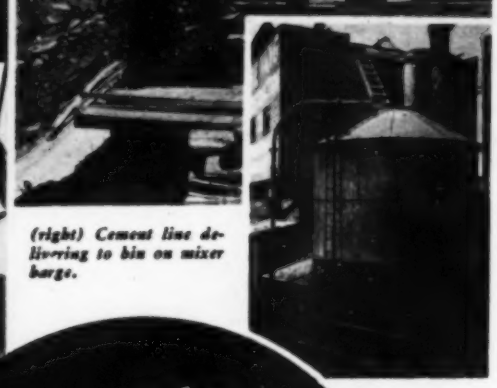
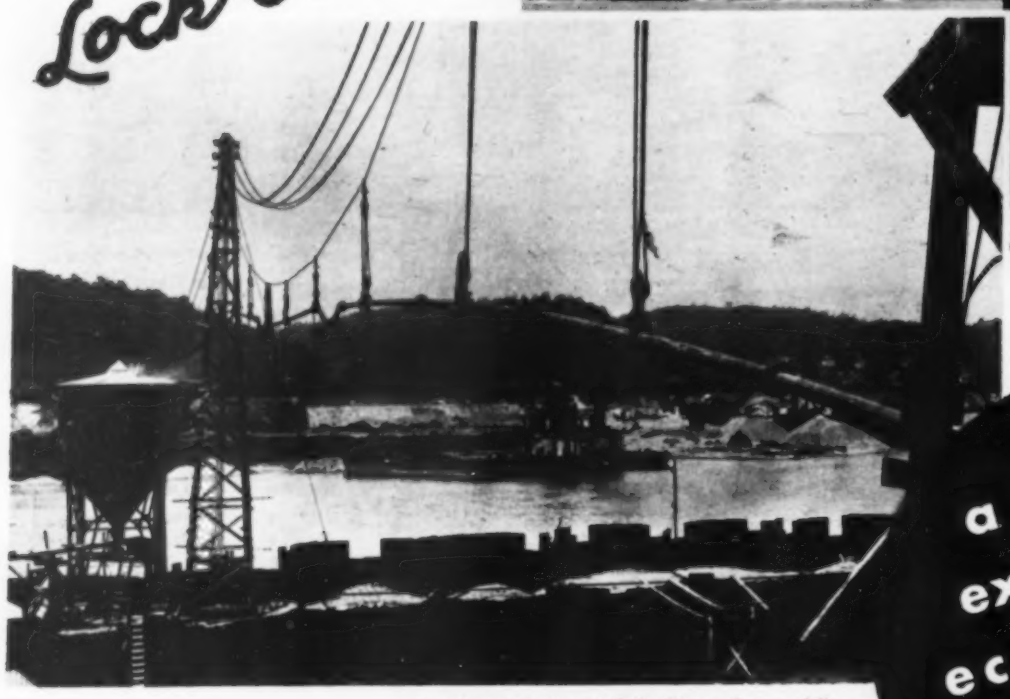


(right) Cement line delivering to bin on mixer barge.



Four inch pipe line of Fuller-Kinyon System, delivering cement from cars to plant on Lock Cofferdam.

a notable example of economy in conveying bulk cement

One plant on each side of river *unloading bulk cement from cars on each side—conveying to bins in stationary and floating cement plants . . .*

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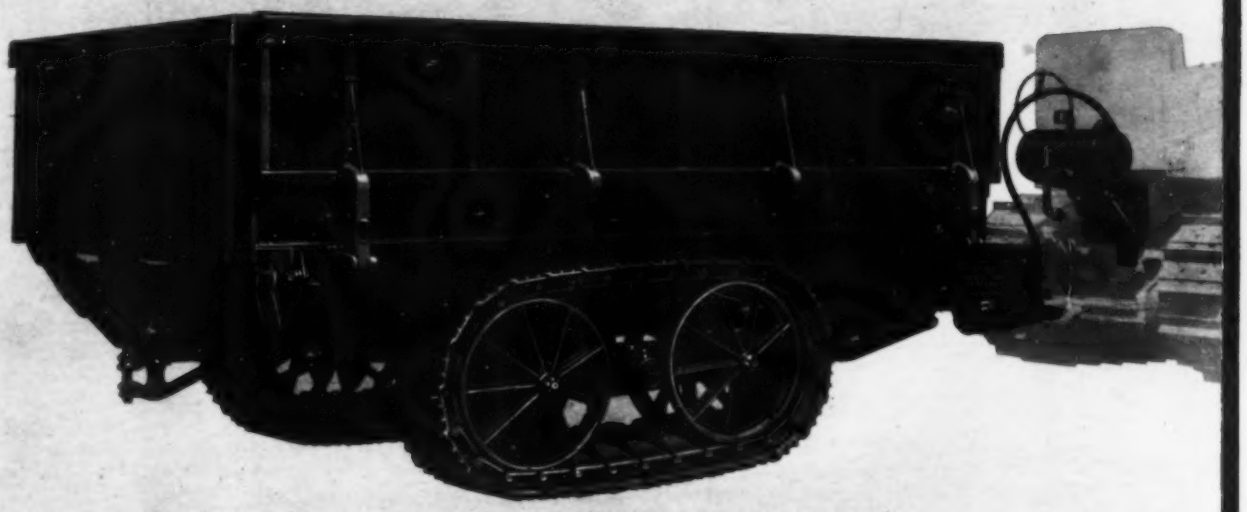

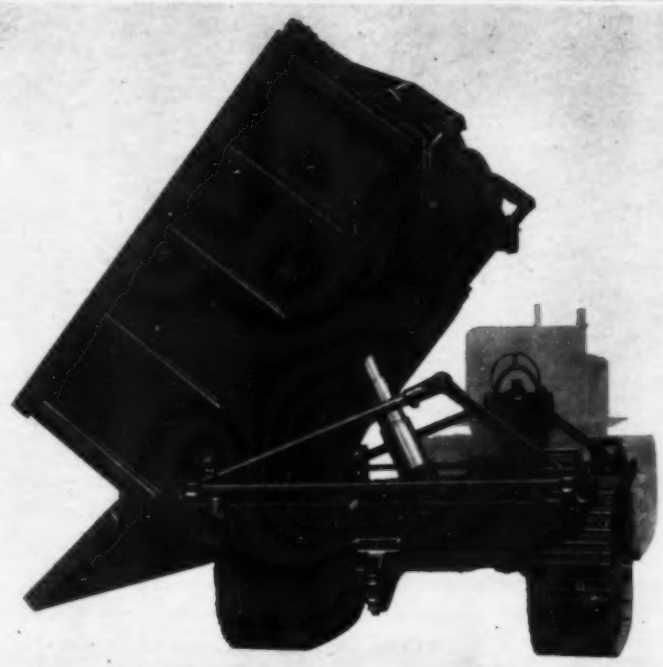

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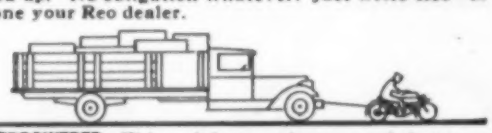
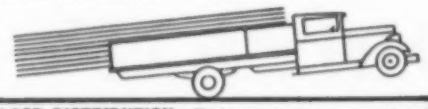
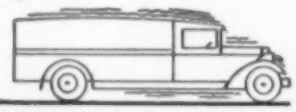


UNDERPOWERED—This unit is so underpowered that gear ratio "doctoring" is necessary to compensate. The result: increased piston travel and gas consumption reduced daily range of travel.



BAD LOAD DISTRIBUTION—This truck has more load back of the rear axle than ahead of it. Very hard on rear tires, axles, gears, bearings, springs and frame. Steering and front brake efficiency greatly reduced when climbing hills.



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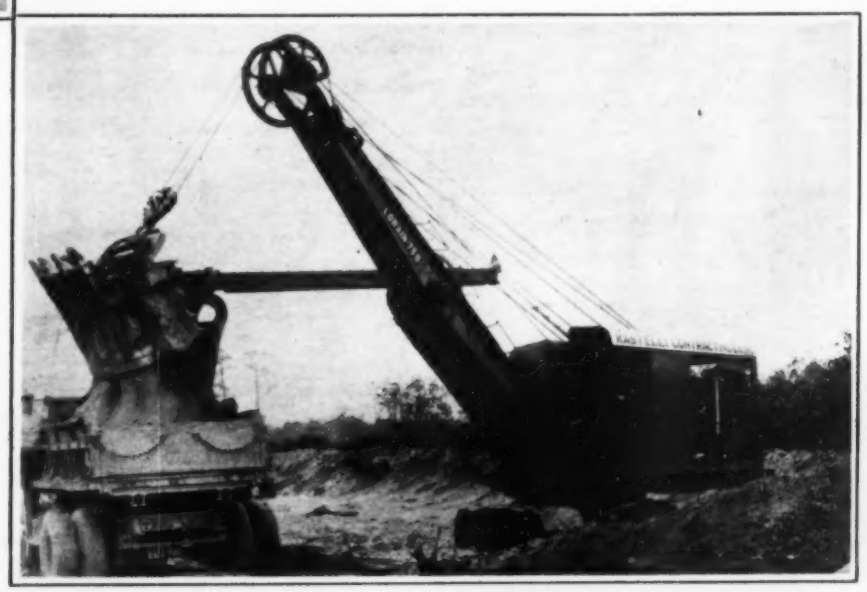

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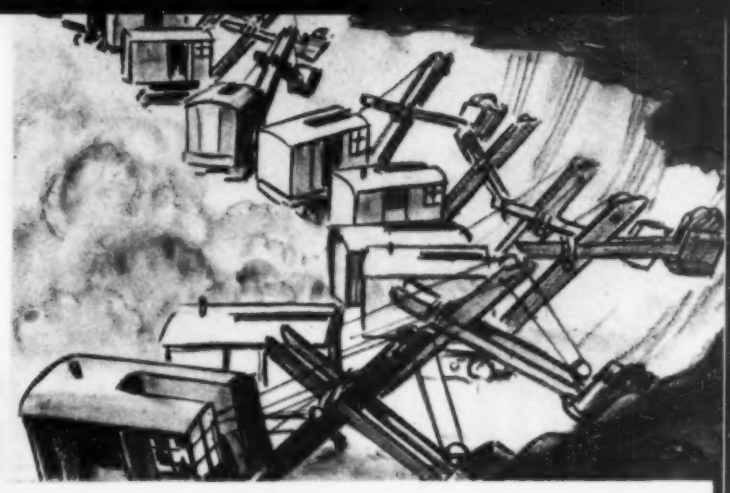

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P&H wages war on dirt moving costs

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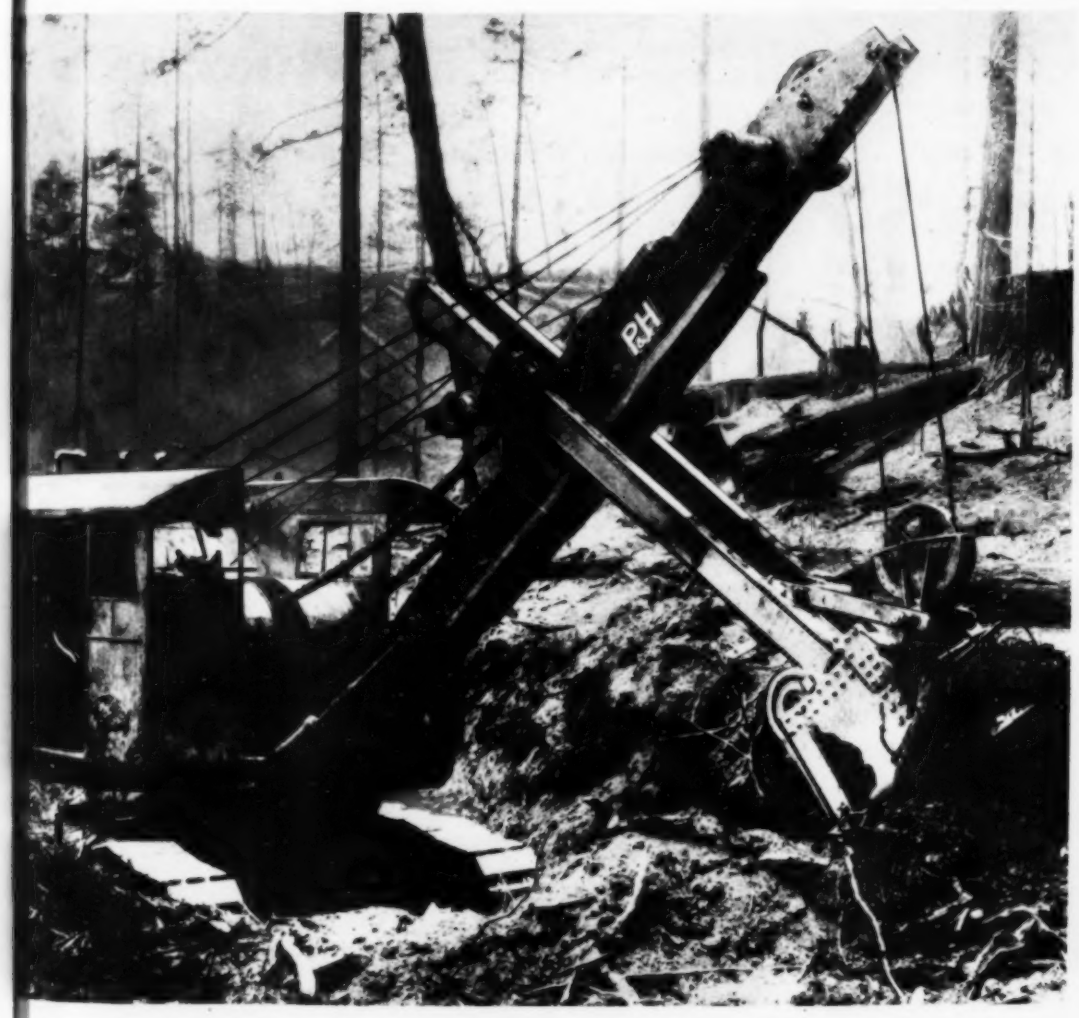

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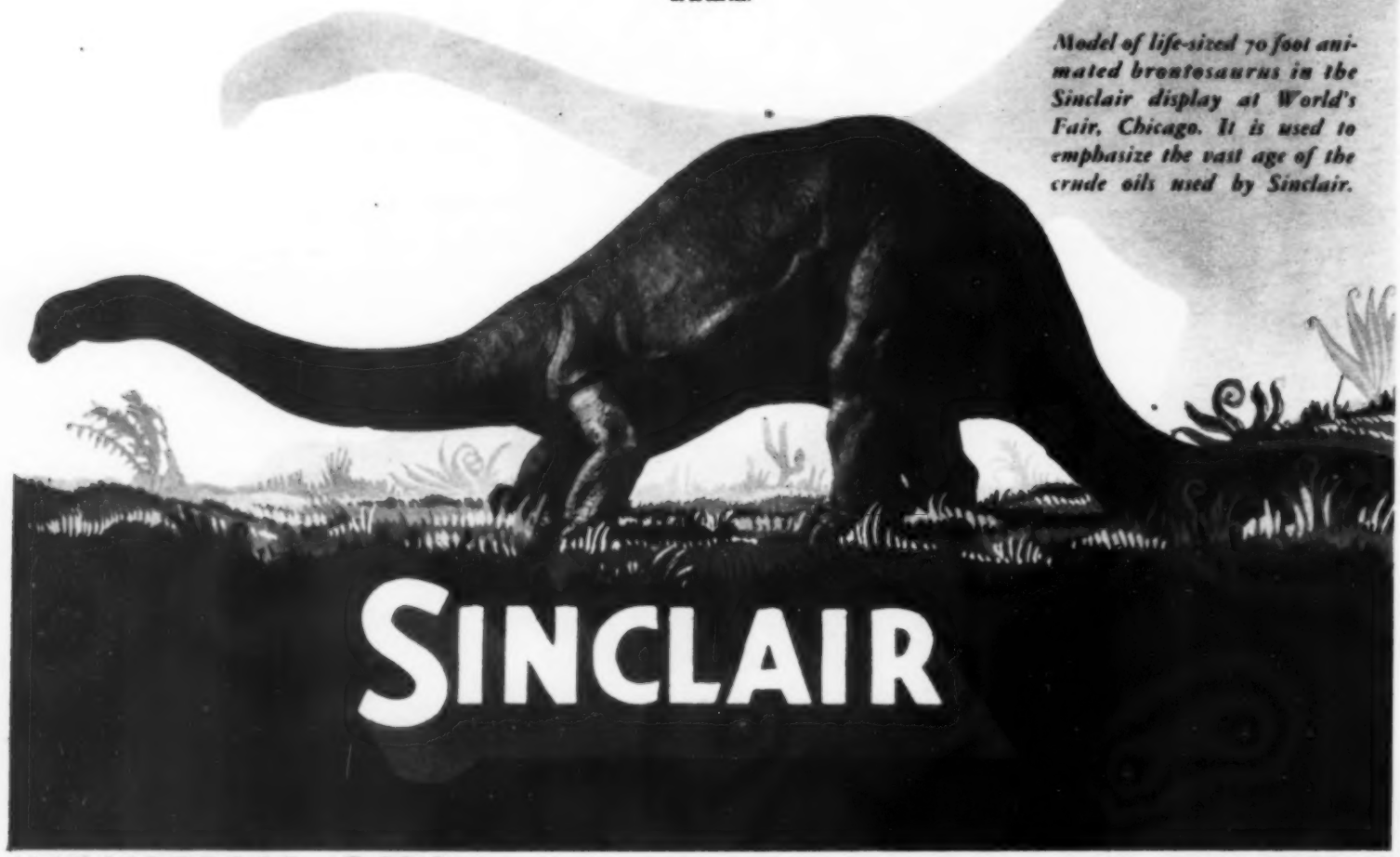

Model of life-sized 70 foot animated brontosaurus in the Sinclair display at World's Fair, Chicago. It is used to emphasize the vast age of the crude oils used by Sinclair.

INDUSTRIAL OILS **GREASES**

Construction Methods

ROBERT K. TOMLIN, Editor

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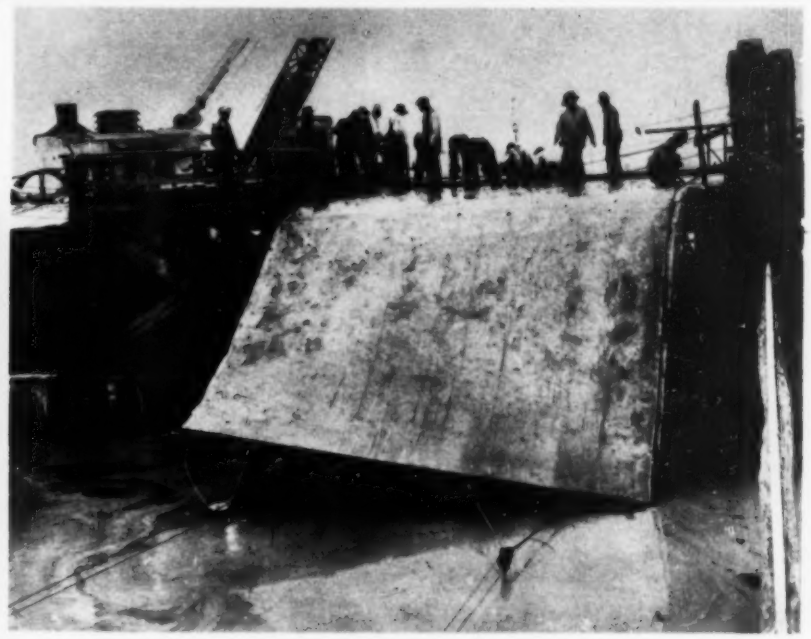

Test River Bank Protection With

ASPHALT MATTRESS

FOR PROTECTING the banks of the Mississippi River from scour and undercutting, an entirely new type of revetment, in the form of a flexible, reinforced asphalt mattress, has been developed and used, experimentally, by the U. S. Engineer Office at New Orleans, La., under the direction of Lieut. Col. J. N. Hodges, district engineer. Previous standard forms of revetment had included willow mats of two types, articulated concrete blocks and large overlapping flat concrete slabs or "shingles", as described in *Construction Methods* for March, July, September and October, 1930. The asphalt mattress, therefore, represents a radical departure from former revetment practice in the use of bituminous material instead of willows or concrete for river bank protection on the Mississippi.

At New Orleans the U. S. Engineer Office, with an experimental plant, built and placed an asphalt mattress 20 ft. wide and 300 ft. long in a swift flowing current of water 90 ft. deep. As a result of this test, it was decided to construct for regular service a large plant capable of fabricating and placing asphalt mattresses 220 ft. in width and of any desired length in depths of water up to 160 ft.

The design for the asphalt mattress provides for a slab thickness of 2 in., reinforced with No. 12 commercial wire fabric having a mesh of 2x4 in. The mattress is fabricated on a barge equipped with a steel plate molding deck upon which the wire mesh reinforcement strips are stretched, laced together at their edges and embedded in the asphalt mixture spread at a temperature of 250 deg. To cool the asphalt mat immediately after being poured, water is sprayed on from above and below the molding deck.

As a result of tests for strength, flexibility and low cost the bituminous mix selected consists of 66 per cent river bar sand, 22 per cent loess (natural filler) and 12 per cent asphalt. The process of molding and launching the mattress, with the aid of 5/16-in. galvanized wire launching cables, is continuous. The barge, starting inshore as the first section of mattress is molded, is pulled out toward midstream, allowing the mat to sink progressively on the sloping bottom of the river bank, as illustrated in the accompanying photographs.

"It is expected," Col. Hodges reports, "that the asphalt mattress will be more effective and more durable than any other type of bank protection used heretofore and at the same time be substantially lower in cost than any other type."

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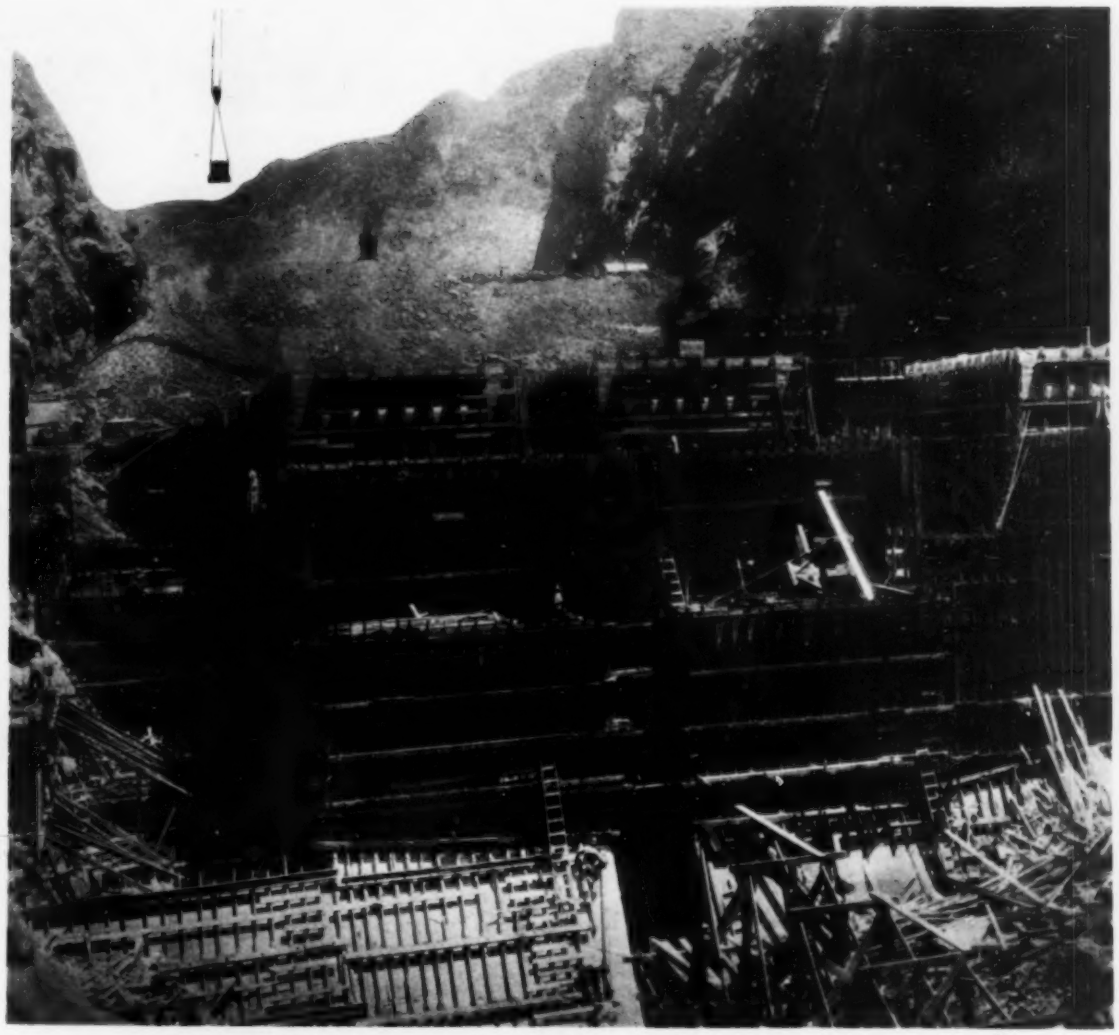
MADDEN DAM, described in March number of *Construction Methods*, takes form as 25-ton cableway delivers concrete to panel forms for 220-ft. high structure across Chagres River to store water for lockages at Panama Canal. Contractors, W. E. Callahan Construction Co., of St. Louis, and Peterson, Shirley & Gunther, of Omaha.

MUNICIPAL AUDITORIUM and community center building at St. Louis, Mo., nears completion by Boaz-Kiel Construction Co. Seven-story structure of steel and concrete, with Indiana Limestone facing, costing $5,000,000, occupies ground area of 322x493 ft. on new Memorial Plaza designed for municipal building group. Architects, La Beaume & Klein, St. Louis.

This Month's "NEWS REEL"

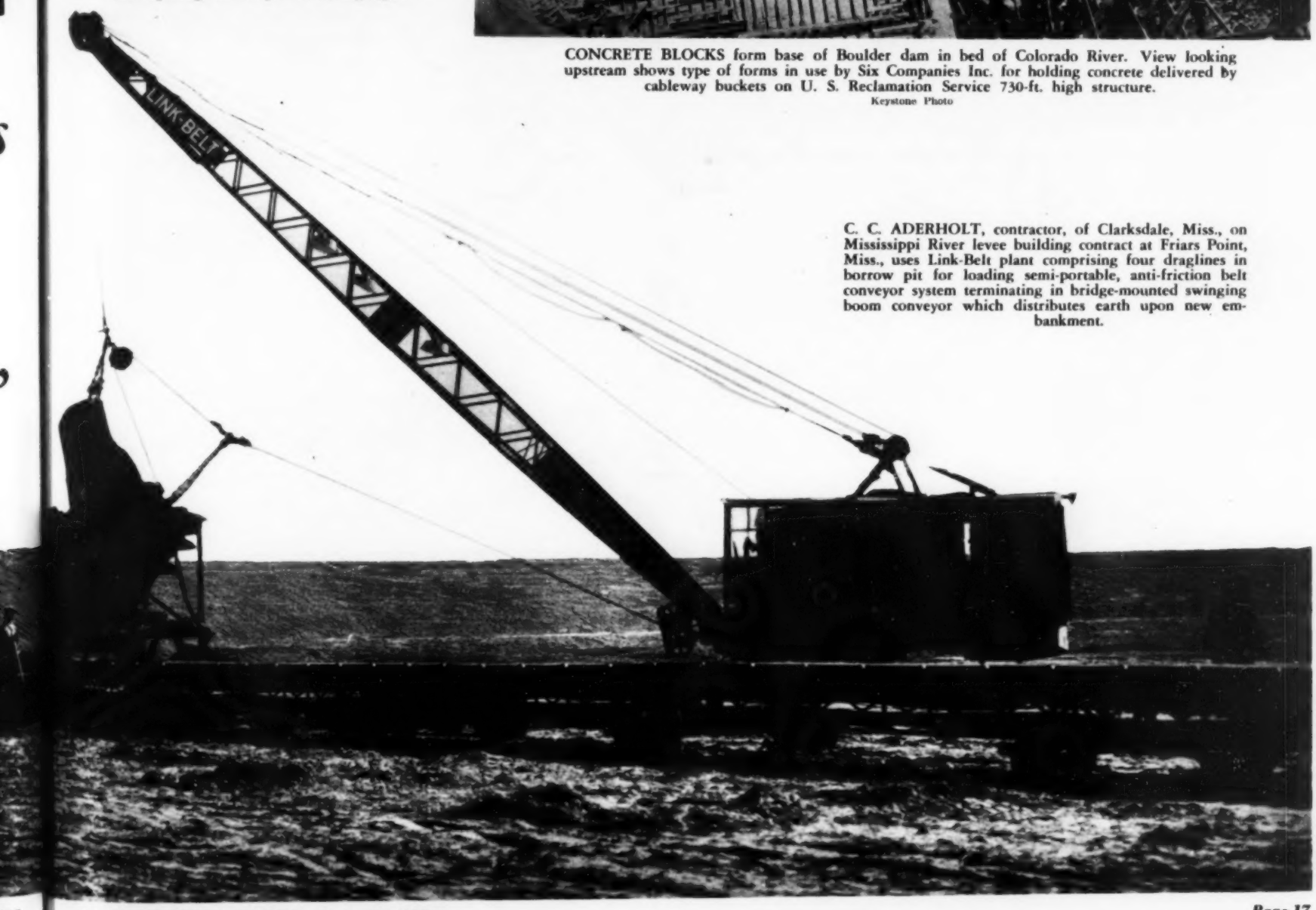
LEVEE - BUILDING WITH BELT CONVEYOR is departure from former standards of practice on Mississippi River.
(continued on facing page)

NOVEL WATER TANK. Elevated structure of 1,000,000 gal. capacity, 67 ft. high, erected by McClintic-Marshall Corp. at Garden City, N. Y., contains aeration system in form of series of trays, suspended from roof trusses, over which inflow cascades before entering storage space. Dome of copper-bearing steel plates has ventilator openings and airplane warning light.



CONCRETE BLOCKS form base of Boulder dam in bed of Colorado River. View looking upstream shows type of forms in use by Six Companies Inc. for holding concrete delivered by cableway buckets on U. S. Reclamation Service 730-ft. high structure.

Keystone Photo



C. C. ADERHOLT, contractor, of Clarksdale, Miss., on Mississippi River levee building contract at Friars Point, Miss., uses Link-Belt plant comprising four draglines in borrow pit for loading semi-portable, anti-friction belt conveyor system terminating in bridge-mounted swinging boom conveyor which distributes earth upon new embankment.

El Capitan Dam Contains 1,700,000 Cu. Yd. of

HYDRAULIC FILL

SPECIAL design provisions to solve the problems usually encountered in hydraulic fill dam construction are the outstanding features of El Capitan Dam now being built by H. W. Rohl and T. E. Connolly, joint contractors, to augment the municipal water supply of San Diego, Calif. The main hydraulic fill section is backed on both sides by extensive loose rock embankments which are carried all the way to the crest as blankets of decreasing thickness. In addition, to insure against possibility of spreading at the base, two concrete arch toe dams are provided. The structure will be 217 ft. high above streambed, 1,200 ft. long on the crest and will store 118,000-acre ft. which will provide a 70-per cent increase in the city water supply.

The dam is located about 35 mi. northeast of the city on the San Diego River and marks the first storage development on the stream, although the municipality has several other reservoirs on other local catchment areas which provide a net safe yield of 14 m.g.d. Ultimately, San Diego will require an augmented supply from the Colorado River and negotiations have already been completed for assuring rights to 100 m.g.d.

HYDRAULIC GIANT washes earth fill, delivered from borrow pit by motor trucks, into puddle core of dam.

Design Features—El Capitan Dam is primarily a hydraulic fill structure with the usual puddle core and concrete cutoff wall. The volume of fill is about 1,700,000 cu.yd. Both upstream and downstream from this earth section are the rock embankments which, at the base, occupy almost one half the thickness of the dam. These rock fills decrease to a minimum thickness of 2 ft. at the crest. Specifications require that this rock be carried up ahead of the hydraulic fill to insure its design purpose of providing stability. The total amount of rock fill aggregates 850,000 yd. The slope and relation of these two fill sections are shown in the accompanying sketch.

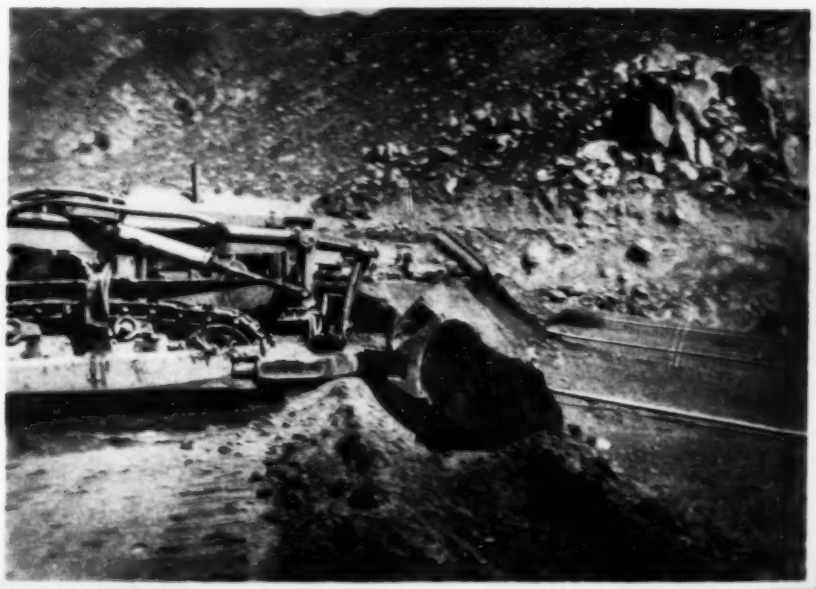
As a further provision against any tendency of the hydraulic fill to slip or spread, particularly during construction—the critical period for hydraulic fill dams—concrete-arch toe dams are included. These 50-ft. dams are arched against the fill and their foundations were excavated 15 ft. into firm disintegrated granite below the general excavation over the site. The tops of these dams coincide with the slope of

IN POOL at core of dam raft-mounted pumps feed nozzles of hydraulic giants at pressure of 50 to 60 lb. Lines from pumps to nozzles are 8-in. steel pipe. Water requirements are 150 gal. per cubic yard of fill.

ROCK EMBANKMENT forms blanket on slopes of hydraulic fill. Portal of diversion tunnel carrying river flow during construction is shown in lower left corner.

the rock embankments and they are completely inclosed in the rockfill when the structure is finished.

The drainage problem resulting from the toe dam on the downstream side was solved by providing a system of drain tunnels extending upstream into the rockfill. These three 6x7-ft. horseshoe-shaped tunnels were built on the level of general streambed excavation and a series of 6-in. holes along their sides allow drainage from the hydraulic fill operations, and after the dam is in service, discharge into the tunnels and through the toe dam. To insure the continued functioning



ROCKFILL from quarry is dumped from motor truck along face of concrete toe dam.

of these tunnels, shafts are carried up to the surface of the rockfill along the inside of the toe dam.

The usual concrete cutoff wall is provided along the center line excavated to a maximum depth of 53 ft. below streambed into disintegrated granite. This 6-ft. trench was backfilled with concrete to the elevation of streambed and then continued for about 10 ft. into the hydraulic fill in the form of an 18-in. reinforced concrete wall. This same type of cutoff is extended up both abutments. Grout holes 25 ft. deep and 5 ft. apart were provided along the bottom of the cutoff trench.

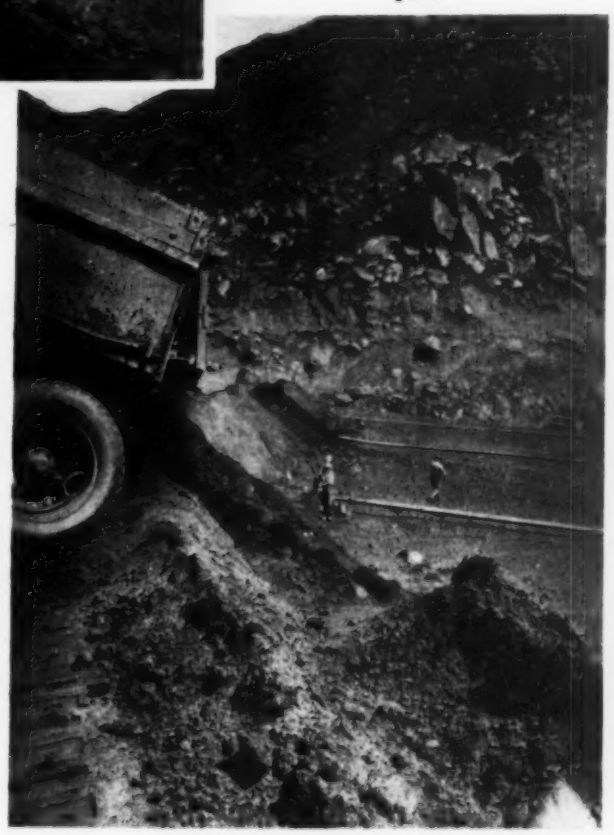
BULLDOZER *(above)* **on Cleveland tractor pushes earth fill within reach of streams from hydraulic giants.**

Construction—Following award of the $2,332,815 contract, construction of a 250-man camp and shops was started in April, 1932. Preliminary operations included driving the diversion tunnel, excavation of the site and opening up the quarry.

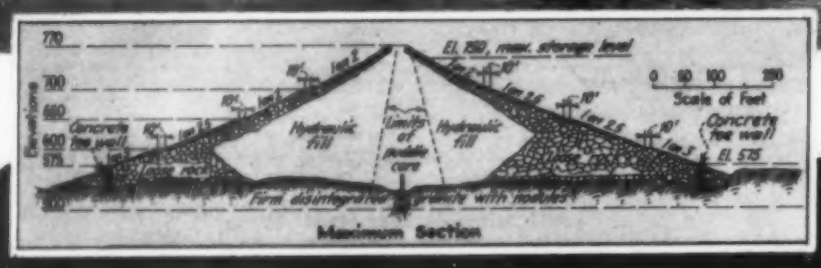
The 25-ft. diameter diversion tunnel is 1,150 ft. long and was driven through the south abutment. It will be used for carrying the flow of the San Diego River during the two-year construction period and will then be plugged near the upper end. Pipes will be left through the plug to connect upstream with an outlet tower and downstream with an 8-mi. supply line to be built to deliver the stored supply to the existing distribution system.

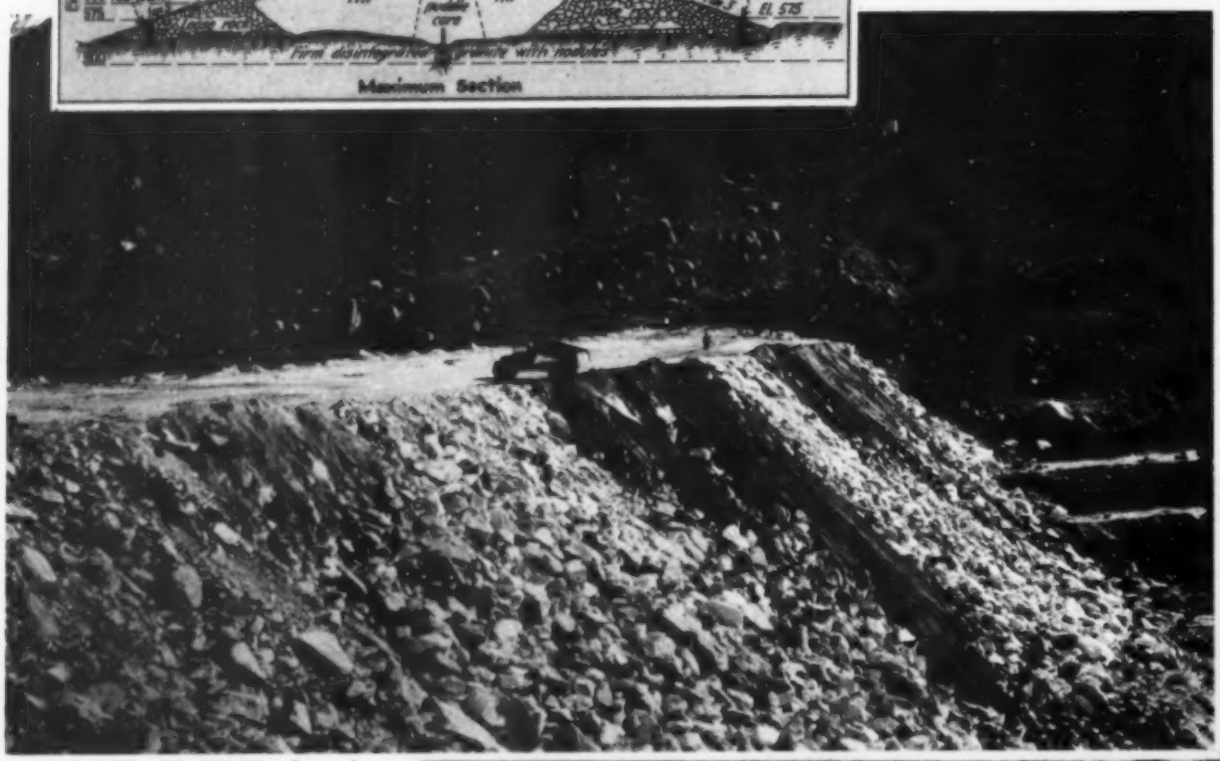
Tunnel driving was carried on from

EARTH *(below)* **for puddle core of dam is hauled from pit by motor truck and dumped along side of pool.**



PORTABLE WASHING AND SCREENING PLANT, including crusher, revolving screens and overhead bins, prepares aggregate for concrete used in toe dams and reinforced cutoff wall.





BLANKET OF ROCK, dumped from motor trucks, covers both upstream and downstream slopes of hydraulically placed earth fill.

both portals with material from the 12x12-ft. pioneer bore loaded by Conway mucking machines into Western 5-yd. cars hauled by Plymouth locomotives. Bench excavation followed with muck handled by a Thew-Lorain shovel at one end and a Bucyrus-Erie at the other. Timbering was required for a short distance at each end and the entire length was subsequently lined with concrete.

Excavation of river deposit and disintegrated granite over the damsite required the stripping of about 300,000 cu.yd. varying from a depth of 25 ft. in streambed to a minimum of 5 ft. on the abutments. Material was removed by power shovels and trucks. Below this general level of excavation the cutoff trench was carried down to a total depth of 53 ft. below streambed. Excavation was done principally by hand inside timber shoring with skips removed by a Lima crane.

Aggregate Plant—Aggregate for the concrete in the cutoff wall and toe dams was produced from a pit in the reservoir site. A Pioneer portable washing and screening plant was in-

ARCHED CONCRETE WALLS, *(below)* 50 ft. in height, are built at both toes of dam to prevent slip or spread of hydraulic fill.

stalled with a Pioneer primary crusher. A Thew-Lorain dragline and 5-yd. Autocar trucks supplied the raw gravel to the plant. The trucks dumped from a ramp into the grizzly and the finished aggregate (sand and three grades of coarse) was delivered into 21-yd. steel storage bins. Aggregate produced in excess of the daily concreting requirments was hauled and stockpiled near the mixing plant. The stockpile was reclaimed with a Barber-Greene loader.

UPSTREAM PORTAL *(right)* **of 25-ft. diameter diversion tunnel 1,150 ft. long which carries flow of San Diego River during construction of El Capitan Dam.**

outer edges and thus obtain a more uniform grading from the core to the rockfill, some material from the spillway excavation was added.

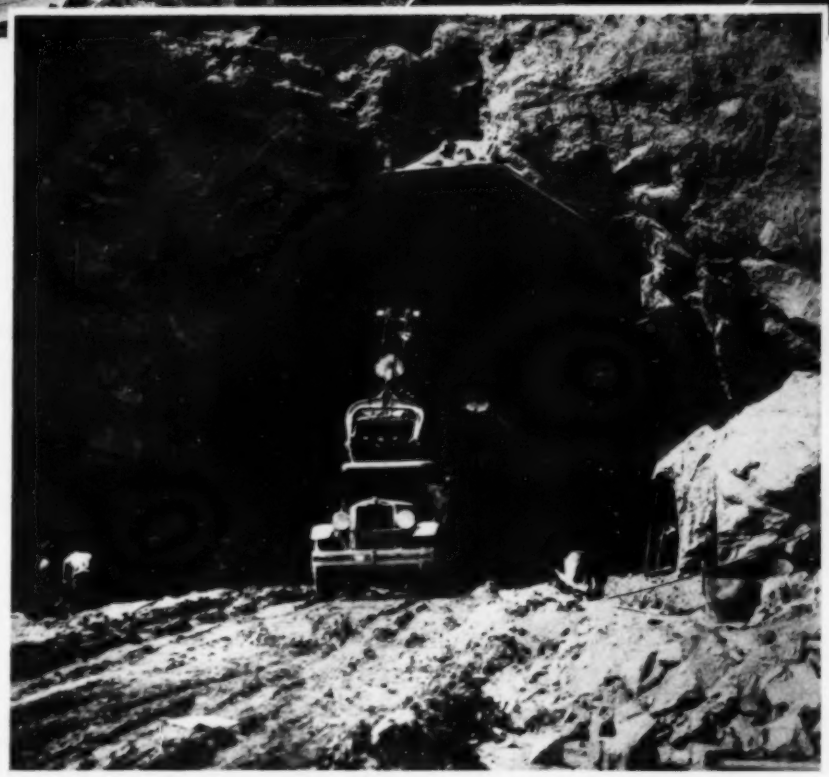
Trucks from the borrow pit operate over the rock embankment sections and end dump toward the center. The material is spread by bulldozers on Cletrac tractors and washed by streams from the hydraulic giants. The pumping equipment is raft-mounted in the pool and consists of two 3-sec.-ft.

HYDRAULIC FILL OPERATIONS ***(below)*** **in progress at El Capitan Dam. Rock embankments on earth slopes provide weight to prevent possible movement of the fill.**

The mixing plant at the site consists of a 300-ton Madsen steel bunker, two 1-yd. Smith mixers, a cement shed and sack cleaner. The stationary mixers discharge into Transit mixers which operate between the plant and the dam.

A quarry for the rockfill was opened about a mile below the damsite. At the start the face was worked with 30-ft. lifter holes at 12-ft. spacing. Later three Armstrong well rigs were used to drill down-holes to develop a quarry face 2,000 ft. long. Loading is done with two Marion electric shovels, one Thew-Lorain and one Northwest. During maximum quarry operations 5,000 yd. per day were moved in two shifts.

Hydraulic Fill—Material for the hydraulic fill was obtained from a well graded pit about 1½ mi. upstream in the reservoir site. The pit required no stripping, and the material is excavated by power shovel and moved by truck to the site. Tests indicated that the material was excellent for this use To provide a more porous fill at the



DIVERSION TUNNEL, after carfying river flow during construction, will later be connected with reservoir outlet tower.

pumps supplying 2-in. nozzles and two 4-sec.-ft. pumps using 3-in. nozzles. The pumps are electrically operated and maintain a 50-60-lb. pressure. Lines from pumps to nozzles are 8-in. steel pipe, and the distance does not exceed 200. ft. Water requirements for pool operation average about 150 gal. per cubic yard of material, which about equals the amount of water to fill the voids. Hydraulicking is generally carried on for two shifts per day with from 8,000 to 12,000 cu.yd placed. The total amount of fill is about 1,700,000 cu.yd.

El Capitan Dam project is being carried out under the general direction of H. N. Savage, hydraulic engineer in charge, Bureau of Water Development, San Diego, with Fred D. Pyle, principal assistant engineer, and Harold I. Wood, resident engineer. D. W. Albert is in direct charge of hydraulic operations. The contract for construction of the dam is being carried out by H. W. Rohl and T. E. Connolly as joint contractors. O. C. Steves is superintendent

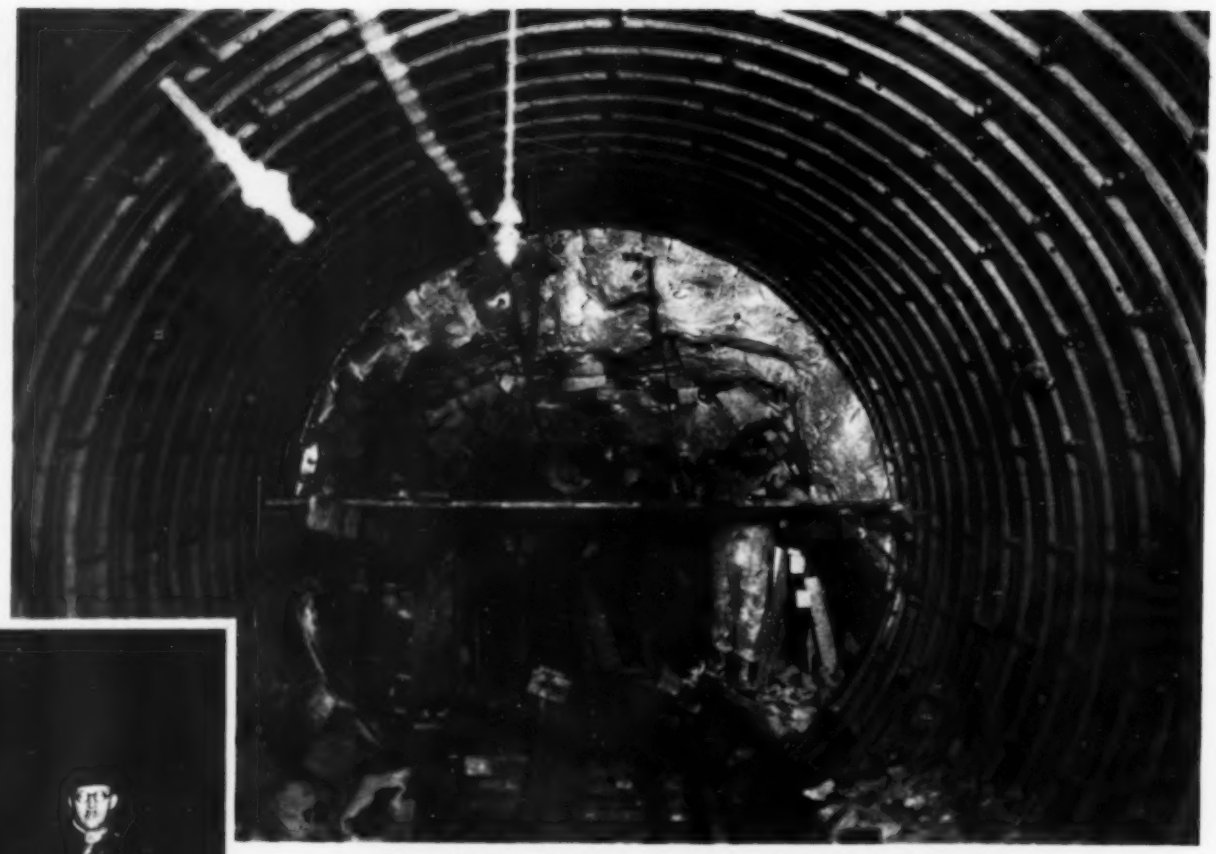
Water Conduit Service Requires

STEEL LINER PLATES

in Moffat Pioneer Bore

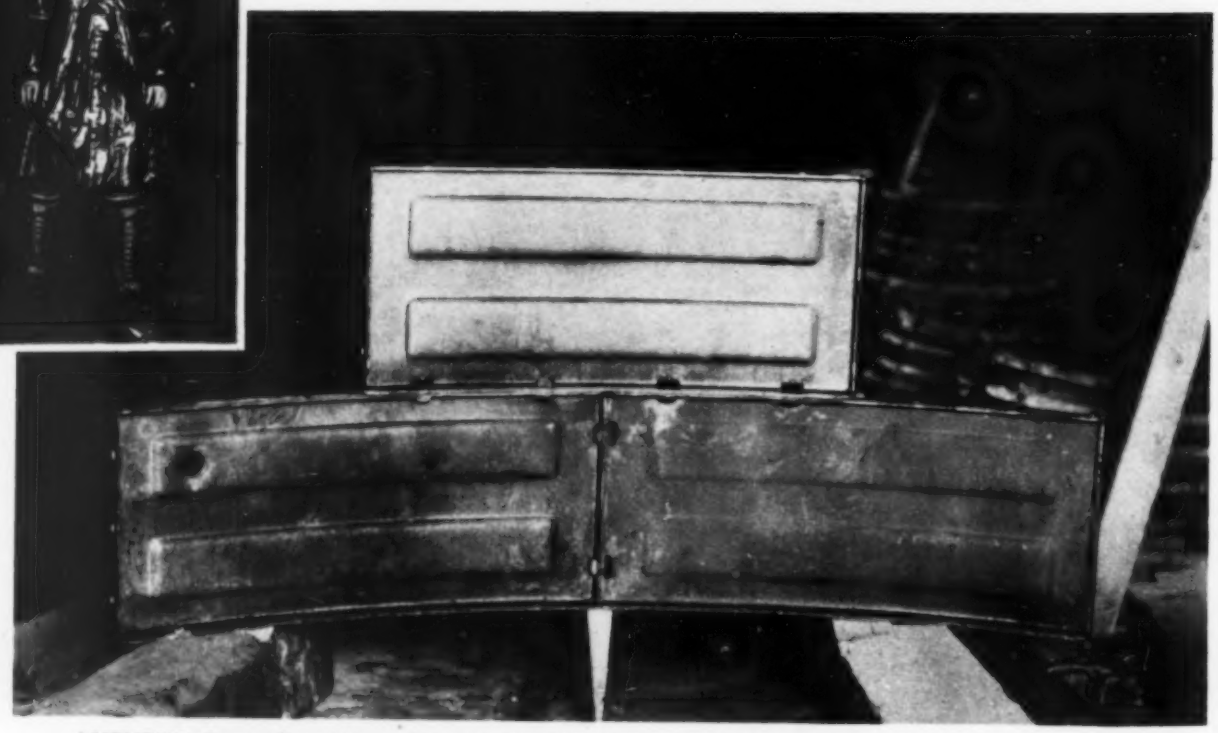
STEEL liner plates coated with gunite have replaced timber lining in sections of bad ground aggregating more than 1½ mi. in the Moffat pioneer bore, 6.1 mi. long, which eventually is to serve as a conduit through the Continental Divide for water diverted from the Fraser River for delivery to Denver, Colo. When taken over under lease in 1929 by the Board of Water Commissioners of the City and County of Denver, 1,516 ft. of the pioneer bore already had been lined with steel plates by the Moffat Tunnel Commission. Since that time, the board has installed Truscon steel liner plates in about 7,000 ft. of enlarged tunnel.

Driven originally as a twin heading to expedite construction of the Moffat railroad tunnel, the pioneer bore penetrates the same rock formations which made driving of the larger parallel tunnel so hazardous and difficult. As a result of these rock conditions, ground pressure on the timbers was heavy in some sections of the pioneer bore.

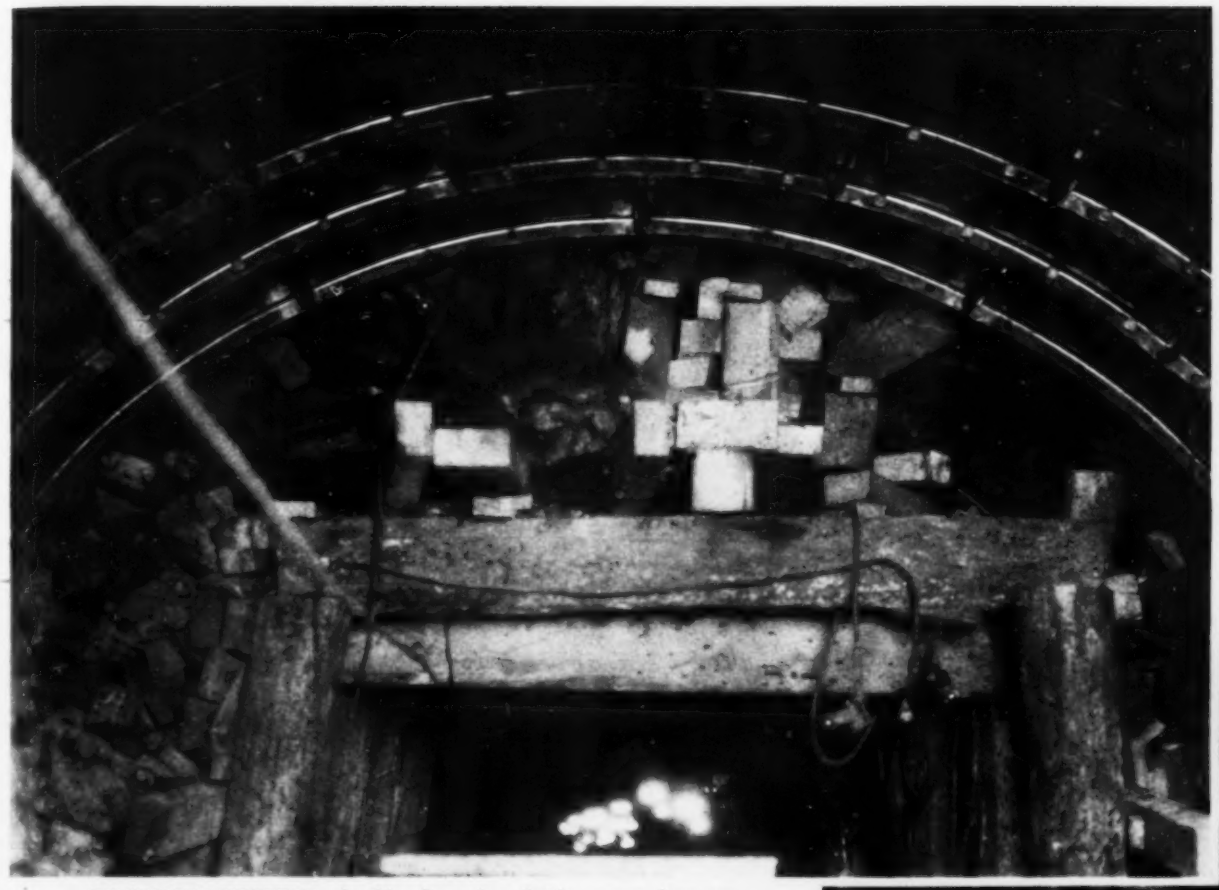


STEEL LINER PLATES are assembled to form cylinder 13 ft. 4½ in. in diameter where enlarged bore of Moffat pioneer tunnel pierces bad ground. Concrete lining will be placed later within steel plate lining.

ENGINEER PERSONNEL. *(Left to right)* Herbert S. Crocker, consulting engineer, of Denver; Glenn G. Gentry, superintendent; and D. D. Gross, chief engineer of Denver's Board of Water Commissioners.

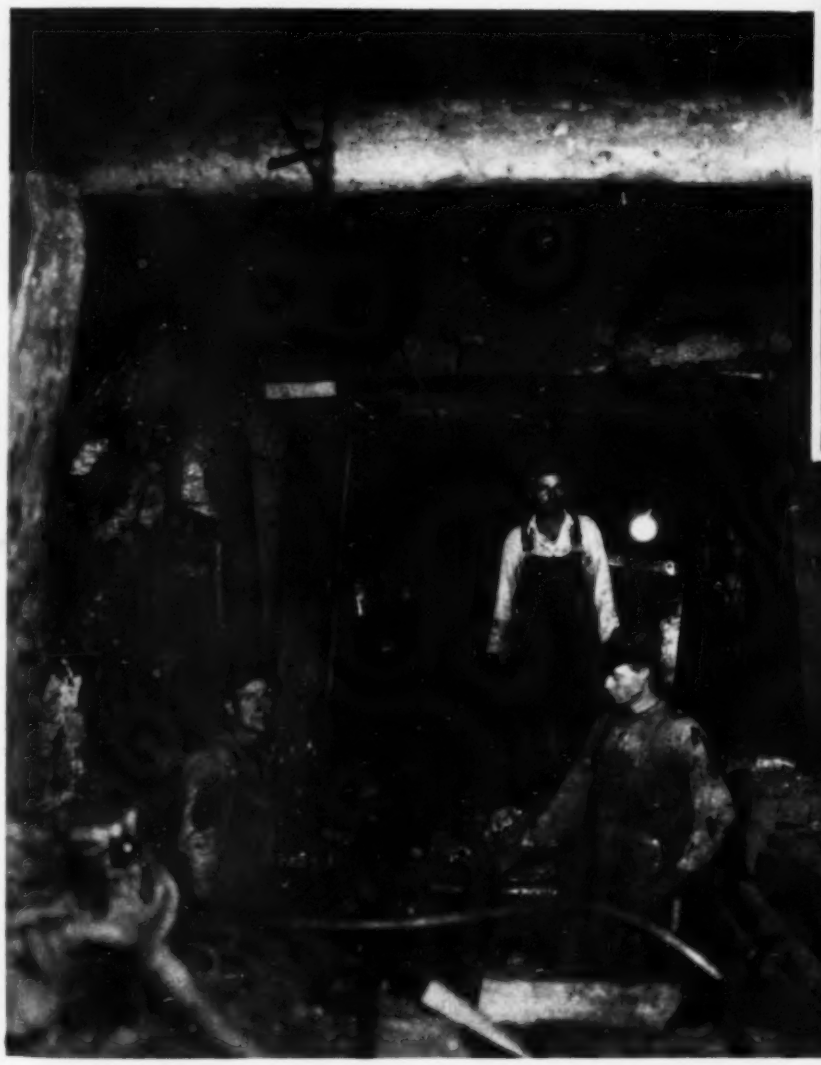


ASSEMBLY of pressed steel liner plates, showing stiffening ribs, bolted connections and hole (at left) for grout pipe. Plate dimensions are ¼x16x36 in. Fourteen plates form circle.



IN HEAVY GROUND of schist formation 4x6-in. crown bars are placed over steel liner plates to support rock during enlargement of original 8x9-ft. timbered section of tunnel.

GUNITE is sprayed on liner plates to protect them from rust prior to placing of 18-in. concrete lining.



ENLARGING timbered section of 8x9-ft. pioneer tunnel bore. Section of steel liner plate can be seen in upper left hand corner of timbering.

Moisture and other unfavorable conditions, furthermore, caused rapid decay of the timbers. Instead of making the frequent renewals of timbering required by these circumstances in the sections of bad ground, the water commissioners decided to continue the installation of steel liner plates begun by the tunnel commission. In carrying out this plan, the sections of worst ground were selected for first relief and the less dangerous sections for later installations. The tunnel was enlarged before the steel plates were installed.

As originally constructed, the tunnel was about 8x9 ft. in cross-section. The water tunnel is to be circular in section and is to have a finished diameter of 10½ ft. inside an 18-in. reinforced-concrete lining. Steel liner plates ¼x-16x36 in. in size have been installed, fourteen to each ring, in the enlarged tunnel sections to form cylinders with outside diameters of 13 ft. 4½ in., sufficient to provide for the reinforced-concrete lining and give the required finished diameter. Enlargement usually was carried on only one or two rings in advance of the steel lining, as indicated by the photographs.

Holes for grout pipes were provided in 10 per cent of the plates, and grout was forced back of the lining to fill all voids. Gunite was applied to the surface of the steel plates to preserve them until the permanent concrete lining is installed.

Most of the tunnel sections lined

THROUGH MAJOR FAULT SECTION rock was supported by heavy five-segment timber sets.

LARGE OVERBREAK in original tunnel on south side of liner plates. Loose rock packed behind plates

GROUTING is employed to fill voids in rock packing between steel lining and enlarged bore of tunnel.

with steel plates had walls of soft rock or of blocky rock which would not stand. At one point, however, the tunnel crew encountered a seam of soft, dry material which ran, causing a serious cave-in. Before installing the steel liners at this location, the engineers placed a heavy lining of reinforced concrete to compensate for the lost ground. Grout pipes extending high into the back of the caved section were cast in the concrete, and vent pipes similarly were installed to release the air trapped by grouting. The steel-plate cylinder was built to the usual diameter inside the concrete lining. No cracking of the gunite coat on the steel plates has occurred, indicating that the concrete backing has served to dam and stabilize the material surrounding this section of the tunnel.

Practically all the bad ground in the tunnel now has been taken care of with the exception of 3,000 ft. at West Portal. This 3,000 ft. is to be lined without enlarging, as it is planned to admit most of the water to the tunnel under pressure through a shaft now being constructed about 3,000 ft. from West Portal.

A large wood frame structure containing shop equipment and supplies gives access to the west portal of the water tunnel, and the 3,000 ft. adjacent to this portal is heavily timbered. To protect this portion of tunnel against the spread of fire originating in the shed at the portal, fire doors of corrugated iron and asbestos were set in a concrete frame inside the bore near the portal. Melting of a fusible link causes one door to shut, striking a trigger which releases the catch on a second door. Both doors are pulled shut by weights.

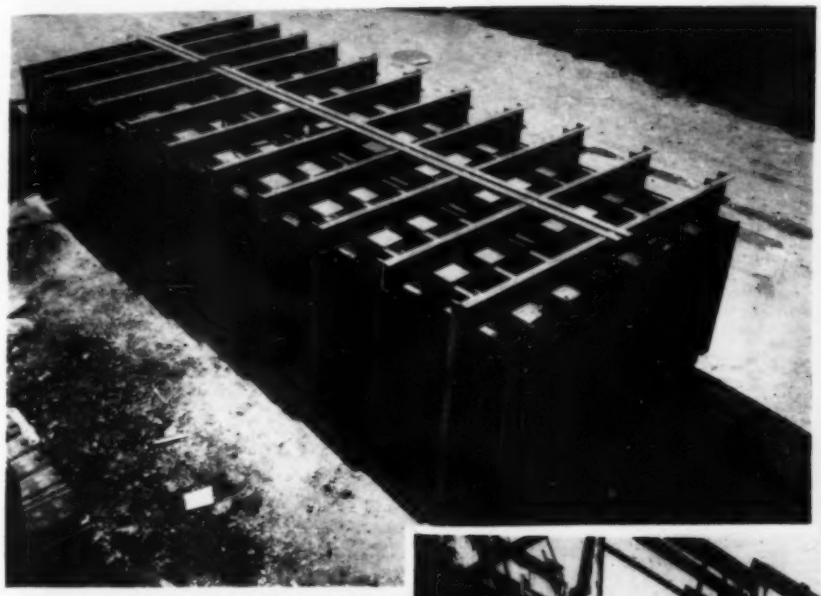
D. D. Gross is chief engineer for the Board of Water Commissioners, and Glenn G. Gentry is superintendent. Acting as consultant on the enlargement and lining of the water tunnel is an engineering board made up of George M. Bull, Herbert S. Crocker, and George Lewis.

RUN OF FINE MATERIAL from narrow seam causes cave-in which buries muck bucket.

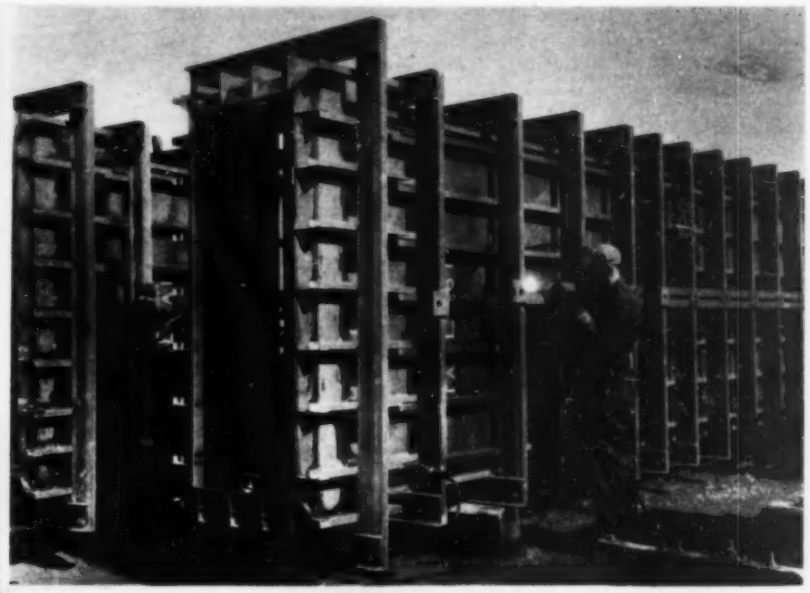
SPECIAL REINFORCEMENT placed to strengthen section where cave-in, shown in picture at left, occurred.

Concrete for Cleveland Bridge Cast in

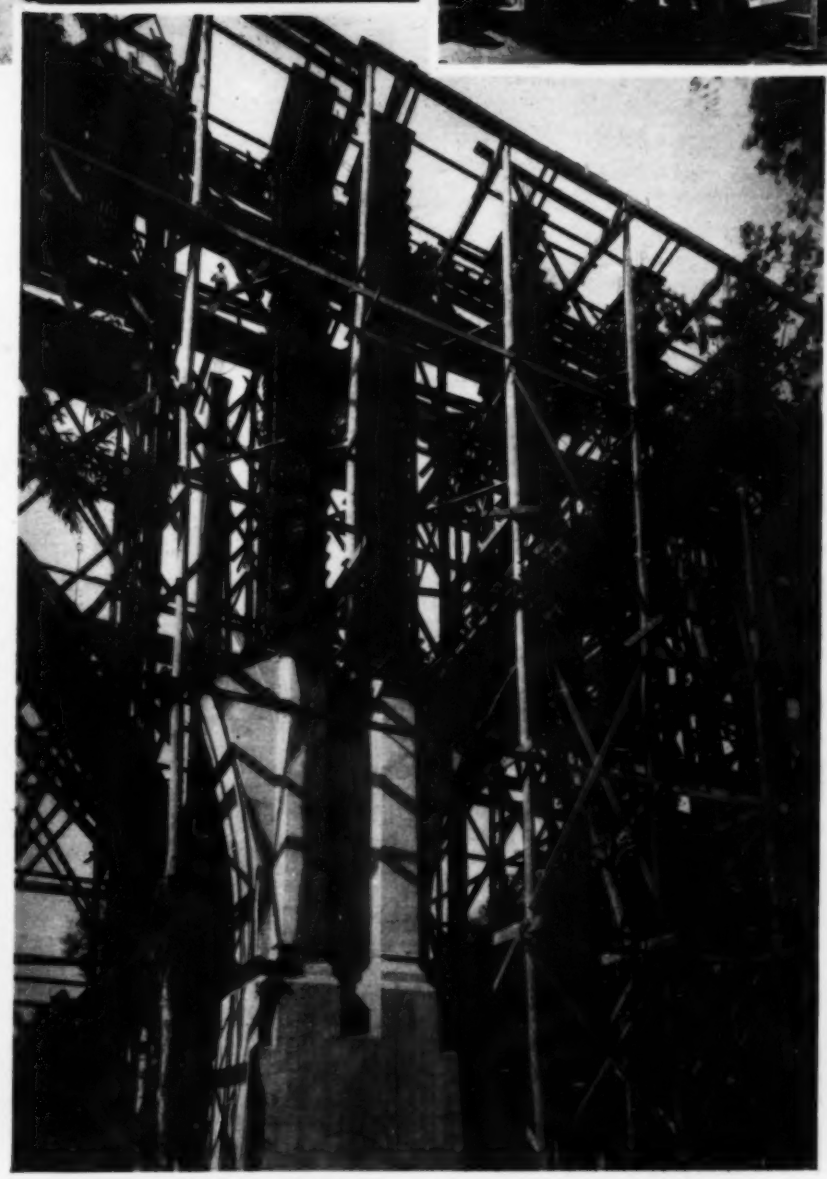
Arc-Welded Forms



PLATES AND CHANNELS, with arc-welded connections, are used in fabricating large steel forms for Brookpark bridge.



FORM FOR CAPITAL, lying on its side, is provided at top end (left) with two-section construction for height adjustment.



PIER COLUMN FORMS in place. Largest sections consist of three form units bolted together to reach height of 57 ft. 5 in.

ALL-STEEL, arc-welded forms for the concrete columns are a construction feature of Cleveland's new 2,500-ft. Brookpark bridge across the Rocky River valley. The bridge, a state highway department project, is to cost approximately $450,000. It is nearly ½ mi. long and approximately 110 ft. high, with a 40-ft. roadway and two 5-ft. sidewalks. The date for completion is set for Dec. 31, 1933.

Steel forms of the size required were decided upon as a measure of economy, for each form can be used 16 times on the one bridge. There are ten columns on each side of the eight arches. The welded forms are an innovation of The Highway Construction Co., general contractors for the bridge.

A typical section of one of these forms is shown herewith. The inside surface is 5/32 in. steel plate, to which are welded longitudinally 3-in. channels with 2 to 3-in. tack welds every foot. Six-inch channels are welded transversely to the smaller channels. For additional stiffening two steel bars are welded to the outside of the channels. The larger channels extend out 6 in. beyond the edge of the plate. At the end of the section steel plate is welded across the ends of the small channels to serve in lining up the section with that above or below and bolting it in place. This constitutes one side of the form. The other sides are constructed in the same manner.

When assembled on the job, the four sections are held together by bolts through the 6-in. channels. One-inch tierods extend through the forms and the concrete at intervals. These rods are in three sections, the two end sections being removable. These may be unscrewed, permitting the removal of the forms and leaving only a section of the tierod buried in the concrete. The tierods are inserted through holes in the plates.

The largest forms consist of three sections bolted together, forming pier columns 57 ft. 5 in. high. The columns taper from 6 ft. by 2 ft. 10 in. at the base to 6 ft. by 2 ft. 3 in. at the top. Some of the larger sections measure 22 ft. 8 in.. in length.

All the forms were produced complete in the shops of The Highway Construction Co., using welding equipment manufactured by The Lincoln Electric Company, Cleveland, Ohio. Dimensions were kept within tolerance limits of 1/16 in.

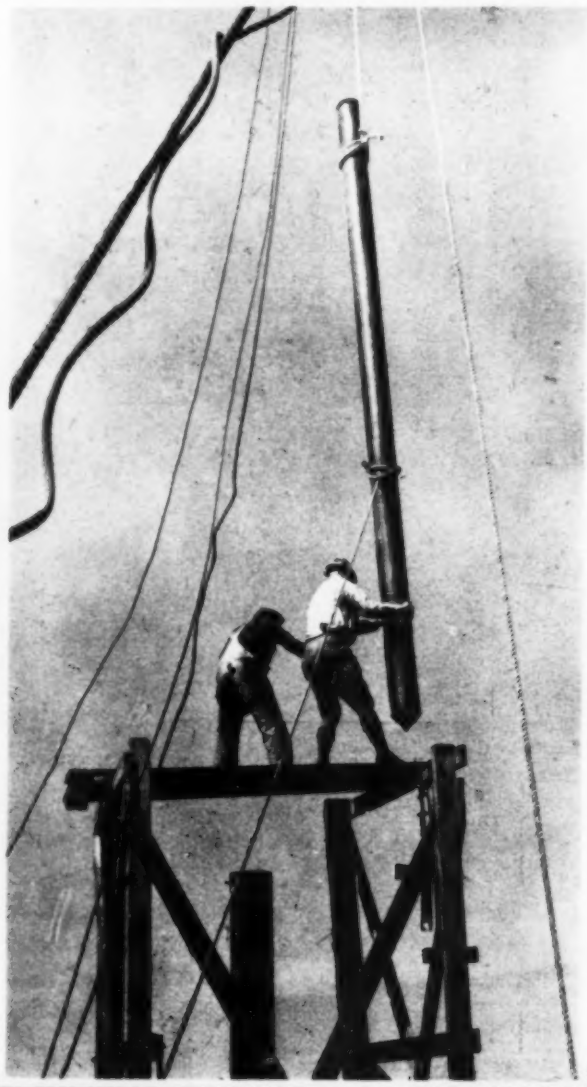
Getting Down to

DETAILS

[Close-up Shots of Job Methods and Equipment]

CHROMIUM-PLATED FLOODLIGHTS on special tripods illuminate night work for West Slope Construction Co. on San Gabriel dam No. 1, in California. New Westinghouse portable lighting units can be carried by one man and set up on steep slopes by means of tripod adjustment.

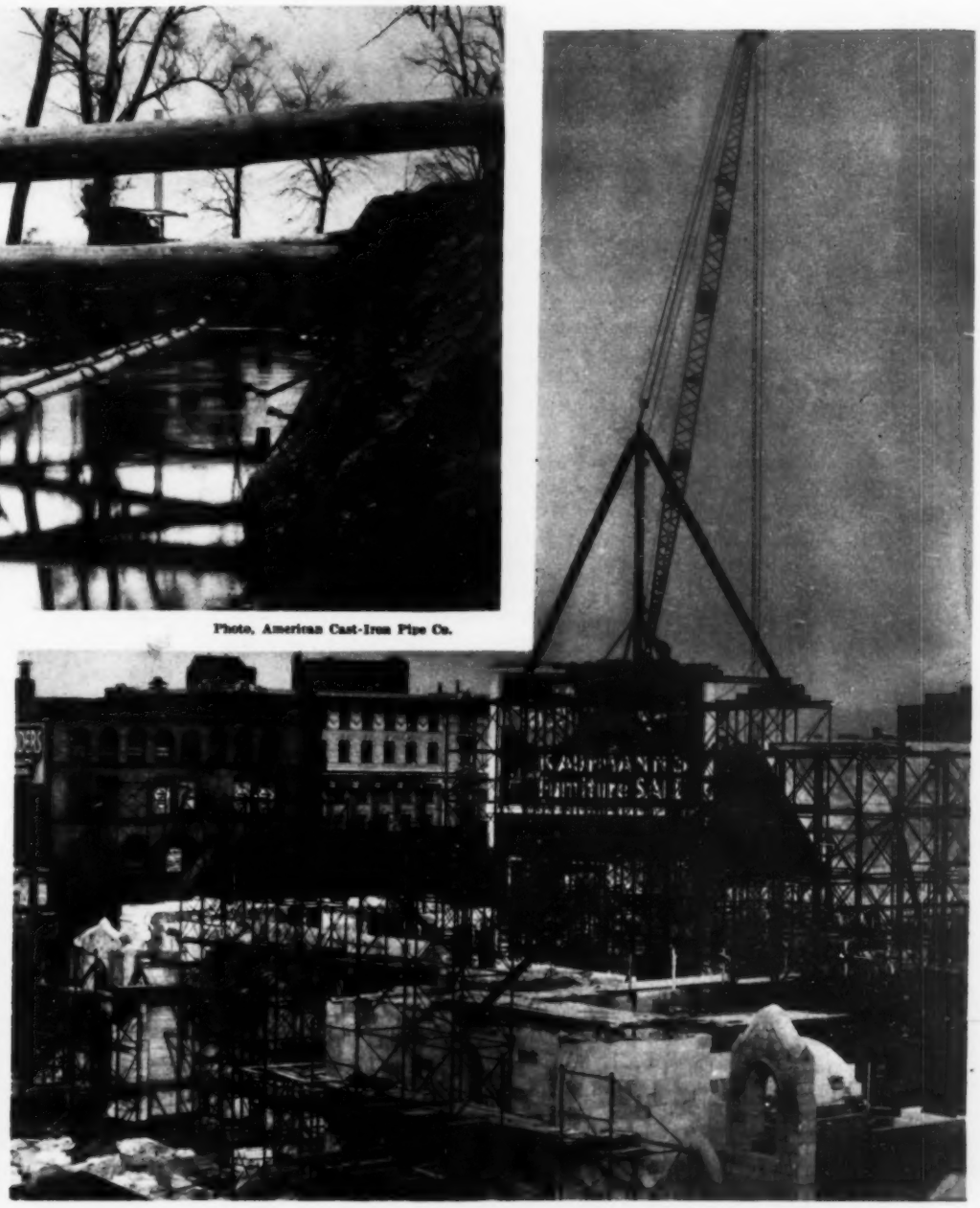
HIGH EXPLOSIVE BOMB *(below)*, weighing 250 lb., is maneuvered by derrick into position for 60-80-ft. drop through 14-in. pipe or bombing barrel to blast subaqueous rock for pier foundation of Golden Gate 4,200-ft. suspension span bridge, San Francisco. Steel legs at 45-deg. angle keep bottom of bombing barrel pipe 10 ft. above rock surface. Bomb is attached by chuck to lower end of 20-ft. length of 8-in. steel shafting weighing 5,000 lb. Contractors, Pacific Bridge Co., for whom Frank Camp developed subaqueous bombing method.



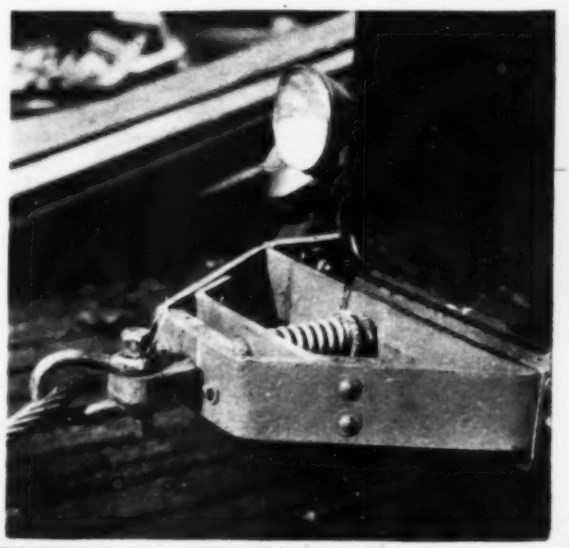
LEVEE-BUILDING BY BELT CONVEYORS is the method employed on Mississippi River at Friars Point, Miss., by C. C. Aderholdt, contractor, of Clarksdale. In borrow pit Link-Belt draglines load earth into hopper above Link-Belt semi-portable belt conveyor system. Bridge-mounted swinging-boom conveyor at end of line discharges fill into levee section at desired point.

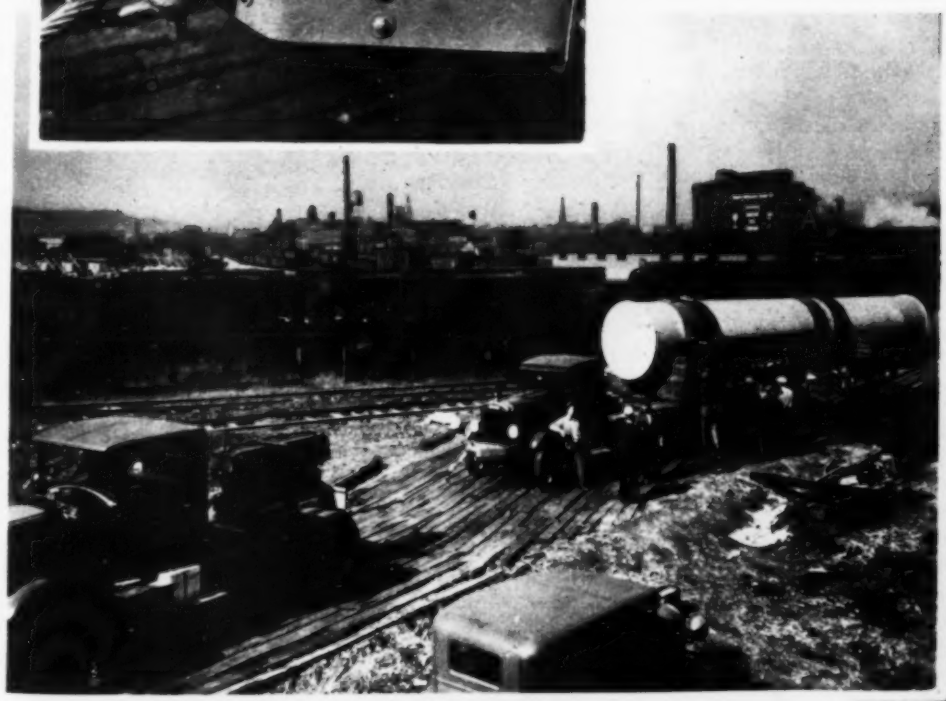
SEWER SIPHON of 12-in. Doublex Simplex cast-iron pipe built by Dept. of Public Service, C. H. Wells, chief engineer, across creek at Newark, Ohio, without resort to cofferdam or pumping. In 3-ft. depth of water power shovel excavated a trench, placing spoil in piles to carry poles supporting pipe every 16 ft. Pipe lengths were floated to place on raft, suspended from poles, joints were bolted and line lowered as unit by slacking off uniformly in ratchets of rope hoists, one under each pole support.

Photo, American Cast-Iron Pipe Co.



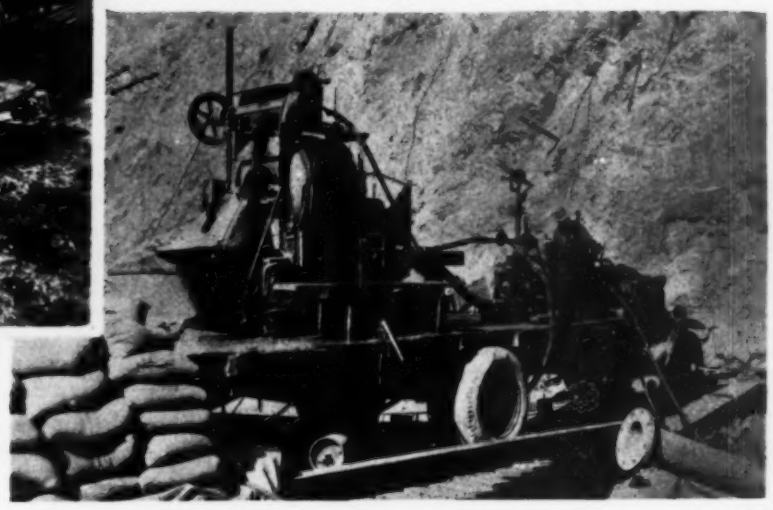
TUBULAR STEEL SCAFFOLD TOWERS, 52 ft. high, support heavy stiff-leg derrick with 80-ft. boom used by Alexander Howie, Inc., subcontractor, to place stone for East Liberty Presbyterian Church, Pittsburgh. Three American Tubular Elevator Co. scaffold units allow derrick to command area between stone block storage space outside building and piers and arches of structure.





TWO TRUCKS IN TANDEM haul 60-ton limestone column 1½ mi. from railroad yard to Mellon Institute of Industrial Research, Pittsburgh, where monolith is erected as described on pp. 36-39 of this issue. Pennsylvania Transfer Co. loads column on Garford truck and trailer and attaches by hauling cable in front Mack truck weighted with 6 tons of pigiron. SPECIAL DRAWBAR FRAME *(above)* to which hauling cable is attached at front of Garford truck prevents distortion of truck chassis. Heavy coil spring relieves starting shocks.

MOBILE GROUTING UNIT *(below)* is used on wall of Nevada spillway at Boulder dam. Six Companies Inc., employs pneumatic-tired truck mounting for mixer and pump.



Helps to Successful Contracting

Twelfth of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

XII—Surety Bonds

By HARRY O. LOCHER
Contractor, New York

THERE is much diversity of opinion with reference to surety bonds. Much of this, no doubt, is due to a lack of familiarity with the practical workings of getting bonded.

Surety bonds are not insurance policies. They are conditional notes made by the applicant, who is called the "Principal", and signed by the surety as an endorser or guarantor. The surety thus guarantees that the principal is both able and willing to pay the obligation circumstances may create.

The surety business may be described as the business of guaranteeing someone else's business. To be able to do so safely, the surety company, through its underwriters, must have a practical understanding of the business of its applicant. One of the reasons why there has been so much misunderstanding between surety companies, on one hand, and contractors, engineers and architects, on the other, is that they do not generally speak the same language in expressing their ideas on construction. There is need for the education of each group in the fundamentals of the business of the other.

It is erroneously assumed in many directions that a surety bond is a guarantee of performance, when it is never actually more than a guarantee of protection against the consequences of a contractor's default. The construction business being hazardous, a bond is used as an inexpensive protection against default. No surety company ever writes a bond unless it is just as sure as the contractor that he can and will complete. Yet surety company losses are heavy.

Surety underwriters, of course, consider the contracting business a business of chance. Their losses occur principally through over-extension, dishonesty, misrepresentation, bad judgement and the occurrence of a catastrophe. A great volume of private construction awarded to strong contractors is rarely bonded, so that the surety companies are obliged to base their experience on work undertaken by what we might call the general contracting body.

Mutual Understanding—As many of our most successful contractors have not been engineers, so many of the best contract bond underwriters have not had the benefit of technical training. They have had good "horse-sense" and ample opportunity to learn the practical problems of the construction business through analysis of their experiences and the experiences of others.

Contractors and surety underwriters would find it considerably to their mutual advantage to know each other personally and to deal directly when arranging a bond. A contractor, thus, has the opportunity to inform himself as to varying underwriting requirements and can plan his activities accordingly. He can also become better acquainted, giving him the beneficial influence that this is likely to have on the consideration of the application by the underwriter of the controlling surety, and on the tenor of such offering as may be passed along to prospective reinsurers. This reinsurance is generally obtained on all but comparatively small contracts in order to give the surety a greater spread of risk and avoid calamitous loss.

Most important of all, however, is the opportunity such an intimate relationship gives to a contractor to demonstrate fully his position: the sufficiency of his price, finances, plant and equipment, capacity and experience, etc., to meet the requirements of the contract. Many facts can thus be developed which are not called for in the application form and they may prove to be the deciding factors in obtaining approval of the risk. This direct personal touch should not be treated lightly.

Broker's Advice—Competent insurance brokers and agents are invaluable aids to a contractor when they act as his agent and advisor. They are generally familiar with the responsibility of the surety companies and, from a broader experience than most contractors can have, they are able to recommend an underwriter of proved ability to care for the contractor's needs. A contractor's experience with surety companies, then, is most likely to be satisfactory when, with his broker or agent as advisor, he deals directly with the underwriter as he does with his banker.

"Contractors and surety underwriters would find it considerably to their mutual advantage to know each other personally and to deal directly when arranging a bond."

However, it is equally as unsafe for a contractor to depend entirely on the ability and experience of a broker, who may not be familiar with the contractor's actual situation, as it is for him to deal directly with a surety company without the advice which a highly competent broker or agent can undoubtedly give as to the best underwriting market for the bonds the contractor may require. Many illustrations could be cited where highly competent brokers have procured bonds for contractors who could not have secured them without such aid.

If a proposed reinsurer knows an application is likely to be declined, but knows how it might be improved, no suggestions will be made so long as another company controls the bond. A few of the older and larger companies go to considerable expense to engage the ablest contract bond underwriters and often employ experienced engineers and practical construction men on their staffs. The qualifications and skill of their organizations are primarily responsible for their success in taking care of the bonding needs of their clients, particularly those borderline cases where the ability and experience of the underwriter results in the writing of a bond which less competent underwriters would decline.

Who Pays?—Bond premiums are not paid by the contractor, but by the owner, either directly or in the contract price. The bond protects the owner against loss, and the only real benefit a contractor can derive from his bond premiums is the good will he builds up through his favor to the company of his selection. This good will often results in the company, which has profited from his business, writing a bond on some large or difficult contract which otherwise might not be an acceptable risk. Thus the contractor may gain an opportunity to earn a profit which would more than compensate him for the slight excess cost of the standard bonds he has used regularly. In recent years contractors have often been called upon by the public and private owners, but at the contractor's expense, to replace bonds of surety companies in liquidation, and this experience has demonstrated the wisdom of selecting sound and experienced companies.

Contract bond premiums are determined on the experience of the surety companies in writing particular types of bonds. Distinction is made in the relative ease or difficulty of performance of different classes of work. These rates must always be approved in advance by the insurance departments of the various states. Since most state laws prohibit discrimination, a surety company cannot vary its charge for similar bonds merely on the comparative ability of the contractor to perform a contract or to indemnify the surety.

Bond Rates—Contract bond rates are based on the contract price instead of the bond amount, because that is the most equitable basis from the viewpoint of the contractor, himself. For illustration, suppose a contractor should take two contracts to build homes for neighbors, in accordance with identically the same plans, and one owner asks a bond of 100 per cent of the contract and the other is satisfied with a bond of 50 per cent. The work is the same and the same general conditions apply to each contract. The contractor's capacity, experience and financial responsibility is equal to both contracts. It becomes obvious that the possibility of loss is exactly the same in each case. This contractor should not pay twice as much for one bond as for the other merely because of the whim of the owner, yet he would be obliged to do so if the premium were based on the amount of the bond.

The bond amount may be said to be the *limit* of the surety's liability, while the contract price is the *measure* of the risk. The surety companies estimate a probable risk of 25 to 50 per cent of the contract price in the event of default. Bonds less than these percentages carry a greater probability of complete loss, whereas bonds for greater amounts will probably not develop a loss of the full amount of the bond. Therefore, contract bond premiums are charged on what is a true index of the comparative difficulty of the contract: the price which the conractor asks for his work. Similarly, fire insurance premiums are charged on the contract value of work done, and compensation insurance is paid for on the value of the labor supplied in the contract.

"Many contractors prejudice their own standing by their failure to give mercantile agencies full information on which to obtain the credit rating they deserve."

As stated before, bonds are not insurance policies, but are guarantees of credit, capacity and solvency. We have stressed the need for care on the contractor's part in the selection of his surety company, for none of us wishes to be passed on as to our qualifications except by those fully qualified to do so. The application form is designed to give the surety necessary information upon which to judge the contractor. When a contractor fails to see that all questions are properly and fully answered, he risks an unfavorable decision due solely to lack of detailed information as to the personnel of his organization, the circumstances of the contract to be bonded and the status of other work on hand. If the financial statement form generally accompanying the application is not completed in detail, particularly with respect to the schedules which describe the various assets and liabilities shown in the statement, then the contractor risks having the underwriter, in his private analysis of the statement, disallow current assets which may be perfectly good (and perhaps very necessary in determining the net liquid worth on which the contractor's eligibility for the bond will finally depend).

Surety underwriters always obtain Dun and Bradstreet reports, and a full and favorable report is very helpful in obtaining a favorable decision. Many contractors prejudice their own standing by their failure to give these mercantile agencies full information on which to obtain the credit rating they deserve. Contractors need not be subscribers to these agencies to be rated, and it costs them nothing but a little thoughtful consideration and attention.

Prequalification — There is established in Washington, D. C., the Bureau of Contract Information, a non-profit-making institution financed by contributions from those benefitting by its service. This institution maintains complete performance records of contracting concerns and of their personnel. The information is available only to those legitimately entitled to it by reason of their being responsible for the writing of contract bonds, the awarding of contracts, or the extending of credit. Full particulars regarding every contractor can and should be filed at the Bureau—without any expense to the contractor.

The application and financial statement forms of the surety companies are designed to apply to a majority of the contracts bonded, but a contractor should voluntarily furnish whatever supplementary information he may have available. The latter may include a description of particularly favorable circumstances concerning the contract or its performance, or an explanation of what the surety may consider unfavorable conditions. Submission of a larger number of references to establish the applicant's credit record, or greater detail concerning his field and executive organization, all for the purpose of demonstrating the capacity of such organizations, are important points which a contractor can well afford to elaborate upon beyond the requirements of the application form.

Investigation by Underwriter—The underwriter, in his investigation, must satisfy himself with respect to each of the following points:

1. The requirements of the contract, and the plans and specifications on which it is based. If difficult or dangerous sub-surface construction is called for, or underpinning of structures, or unusually long maintenance of efficiency guarantees, or maintenance of heavy vehicular or railway traffic, or other peculiar or unusual conditions, then such circumstances will influence the underwriter's opinion of the contractor's ability to perform the contract, taking into account, of course, the past record of the contractor.

2. The general experience of the contractor and what experience he has had in similar work and in previous dealings with owners, engineers or architects.

3. The character, reputation, technical qualifications, and practical experience of the contractor's personnel.

4. His current or liquid financial position.

5. His standing at his bank; his borrowing capacity.

6. Does he treat his subcontractors and material men fairly? Does he pay them promptly? What do they think of his ability, etc.?

7. What is the status of his other work on hand?

8. What is his litigation or lien record?

Especially on the larger contracts, a contractor should always allow his surety as much time as possible to arrange the necessary reinsurance with other companies, many of whose head offices are in different parts of the country. In most cases, a week to two weeks is required. Before submitting any proposal which requires a performance bond to be given, a contractor should always protect his bid check or bid bond by obtaining a written commitment from his surety company direct, not from his broker, definitely agreeing to execute the performance bond in the event of an award.

In this article we have endeavored to describe the methods, practices and requirements of contract bond underwriters and their companies and to impress upon our readers the importance of giving the same measure of intelligent thought to creating and maintaining a satisfactory bonding credit as you are generally careful enough to apply to the maintenance of your standing among subcontractors, material men, and at your bank.

Engineer-Contractor Relationship Discussed

To The Editor of *Construction Methods*:

Sir—With great interest I am reading the series of articles, "Helps to Successful Contracting", by Harry O. Locher, of which the tenth installment appeared in your July issue. I am glad to know that these articles will be continued and I would suggest that they should be reprinted in book form.

I want to read these articles over and over again and have my associates, superintendents and some of my competitors read them, not only once but repeatedly. Mr Locher is doing a great service to engineers, contractors and, in fact, everyone connected or related with construction work. He touches the vital problems of job organization, diplomacy and psychology with a master mind and in a way that everyone should understand and appreciate. Contracting is gradually becoming a fine science.

Our conceptions of ideal work organization and performance have undergone great changes during the last twenty years and still greater changes are ahead of us in the immediate future. I still remember the time when the meanest and strongest man on a job, who had a voice like a bull's and an almost unlimited amount of cuss words at his command, was considered the ideal foreman or superintendent; when the contractor carried his office in his hip pocket; and when the making of estimates or bids for a job was either just a plain guessing contest or the result of figures obtained by some kind of advance information from competing bidders. It was not at all a question of what a job would actually cost; the important thing was to find out what the others intended to bid and to cut under that price. There are still contractors of this type in existence, but they are rapidly disappearing, their places being gradually taken by better educated men with improved business methods.

Mr. Locher's tenth article, "Relations with Engineers", is very good. It covers some of the salient problems of cooperation, and his suggestions should be well taken. This article, however, merely touches the problem. It should be followed up by a much more comprehensive series of articles, for the reason that this relationship is not only grossly misunderstood by engineers and contractors but also by the owners, financiers, corporations or government agencies for which work is being done.

Engineers as Contractors

In these times a large and ever increasing number of highly trained and experienced engineers take up contracting as a profession, frequently as specialists in one or the other branch of engineering construction work. In this case several new complications arise that are different from ordinary lines of friction. If the project engineer is a big man, broadminded and honest, everything is all right. He will appreciate the advantages offered to the owner by specialists' services and at least be fair-minded and open for suggestions.

Very often, however, the engineer has already presented tentative plans and suggestions, and doesn't even consider receiving plans from the specialist contractor or, if he does so, fights with all powers at his command against their acceptance by the owner. He is afraid that his own glory suffers by admitting that any improvements on his plans are possible. His professional jealousy is aroused to the point of actual enmity towards the contractor if the contractor presents, as a last resort, his plans to the owner direct. Of course, it takes a small-minded engineer to take this stand but, not *all* engineers are *great* men, although, they often take the standpoint of unquestioned authority in all matters of engineering work and practice, from the building of a wire fence to and including the construction of a seawall or a suspension bridge. It is the ignorant, conceited, overbearing engineer who is the great danger to the contractor and, of course, also to his employers. The less actual experience he has the more convinced he is of his own sublime superiority. Millions of dollars are being wasted every month by just such kindergarten engineering.

The Contractor's Dilemma

This problem I consider one of the most difficult for the contractor. He usually is at the mercy of the engineer, even if the contractor is vastly superior in every respect by reason of better education, training, experience and social standing. The contractor often is absolutely powerless and not only faces heavy financial losses but also the loss of his reputation and other moral assets. Worst offenders in this direction are some of the younger engineers in charge of public work who seem to measure their efficiency standards by the hardships and misery that they can inflict upon the contractor's organization.

These are only a few of the points that make real cooperation and coordination of interests between engineers and contractors so very difficult, especially for the reason that the contract specifications, constituting the principal laws under which the work is performed, are so decided in pronouncing the absolute dictatorial powers of the engineer. The engineer on the job has also the power to permit or withhold payments to the contractor and is able to inflict severe punishment on him by approving or condemning materials, equipment and workmen for almost any reason that he may choose.

Of course, there are two sides to every tale and an engineer who is unfortunate enough to battle through a job with an incompetent, poorly equipped and low class contractor's organization is not sleeping on a bed of roses although, theoretically, he has absolute power over the contractor.

An ideal condition would be that no man would be permitted to engage in contract work unless he has the requisite technical training and at least five years of practical experience as designing and supervising engineer or architect, and that no engineer would be entrusted with the supervision of construction work unless he has at least five years of practical experience with a contractor's organization. This then would result in vastly superior contract performances and in the saving of untold millions that are now going to waste by incompetent work performance and organization.

I am convinced that Mr. Locher will be able to air these problems and help to bring about a better mutual understanding and respect between engineers and contractors.

Carl Weber, *President*,
Shore-Line Builders, Inc.
Jacksonville, Fla.

Aug. 1, 1933

NEXT MONTH: The thirteenth article in Mr. Locher's series will discuss "Night Work."

GREY STREET BRIDGE, Brisbane, Australia, on opening day. Three 238-ft. river spans consist of concrete ribs reinforced with skeleton steel three-hinged arches erected complete in advance of concreting. Bridge carries 40-ft. roadway and two 11½-ft. sidewalks.

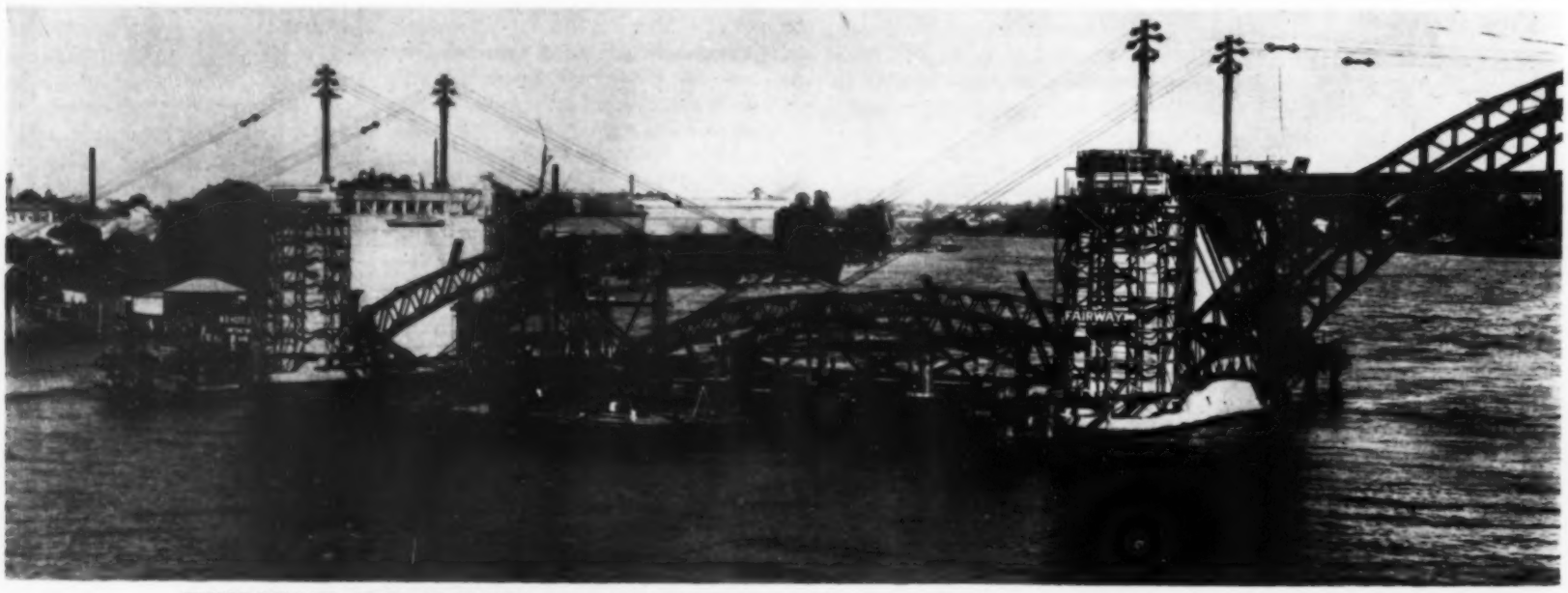
ARTIFICIAL ISLANDS

Aid Sinking of Pier Caissons

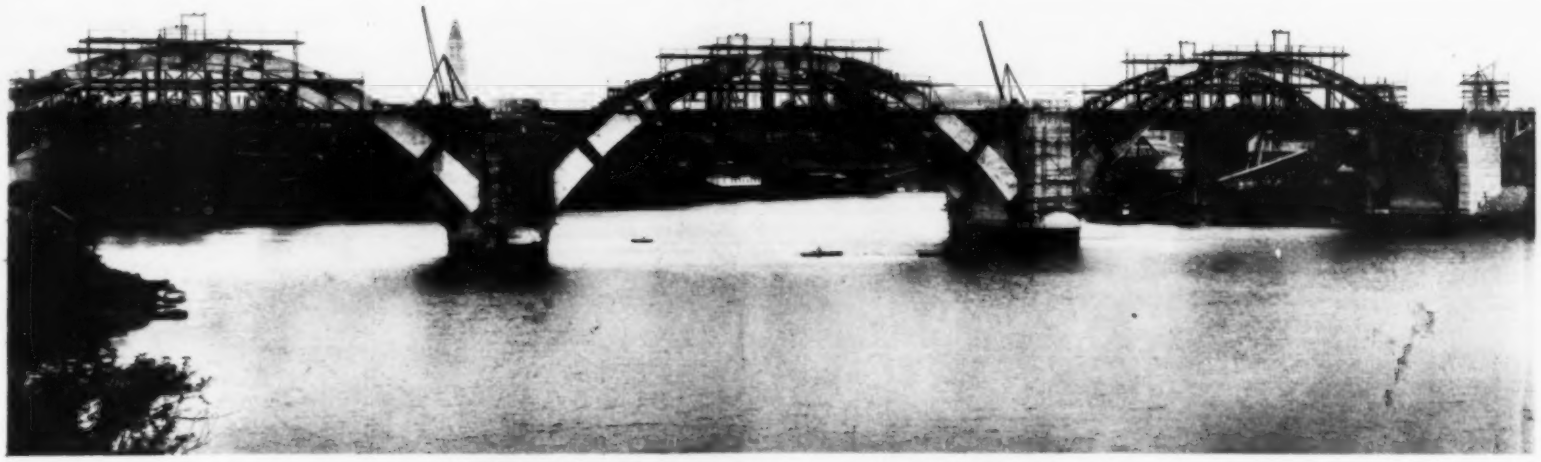
ARTIFICIAL ISLANDS aided the starting and sinking by open dredging of foundation caissons for three piers of the new reinforced-concrete multiple-arch Grey Street bridge across the Brisbane River, at Brisbane, Australia. Pneumatic pressures up to 60 lb. per square inch, required to bottom the caissons in bedrock at a maximum depth of 107 ft. below high tide, were utilized without causing a fatality or permanent disability to any workman. Structural steel reinforcement of the three river spans was erected by the cantilever method as three-hinged arches in advance of the concreting, eliminating need for falsework to support the forms, which were suspended from the steel arches.

ARTIFICIAL ISLAND is constructed by filling with dredged material inside steel sheetpile inclosure.

Three two-rib, reinforced-concrete, 238-ft. through arch spans carry a four-lane highway and two sidewalks across the river, which is about 700 ft. wide at this point. At the north end of the crossing are two 33-ft. reinforced-concrete girder spans. The south approach consists of a 92-ft. deck arch adjacent to the river and sixteen steel girder spans, incased in concrete, varying from 34 to 52 ft. in length. With its approaches, the bridge has a total length of 1,630 ft. The maximum clearance, at the center of middle river span, is 56½ ft. above mean low water.



THREE-HINGED STEEL ARCH RIBS are erected as cantilever arms after sections of each arm have been riveted together on temporary staging. Overhead cables raise two halves of each arch rib to proper crown position.

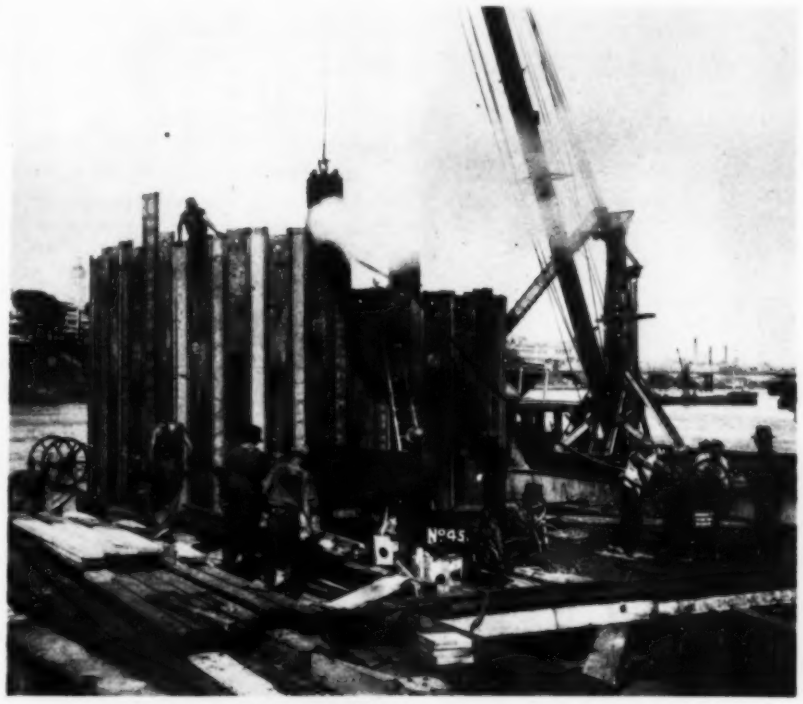


VOUSSOIR SECTIONS of arch ribs are concreted in forms hung from steel arches. Sections are cast in sequence to maintain balanced safe load on steel ribs.

At the bridge site, the river has a maximum depth of about 50 ft. A rock outcrop furnished an ideal foundation for one pier at the north bank, but the south bank consisted of an alluvial deposit. The riverbed is composed of silt overlying bedrock, which occurs at a depth of about 100 ft. Tidal variation in the river amounts to about 8 ft.

Pier Foundations—Each of the two river piers is supported on two reinforced-concrete cylinders 28 ft. in diameter, and the pier on the south bank rests on two reinforced-concrete caissons 20x34 ft. in plan. The foundations of these three piers were carried down to rock at depths 83 to 107 ft. below high tide level. Eight 7-ft. reinforced concrete cylinders sunk 85 ft. to rock support the abutment pier at the south end of the 92-ft. deck arch span. Other piers of the approaches rest on piles of nominal length.

Artificial islands were constructed by the contractor, M. R. Hornibrook, Ltd., of Brisbane, to facilitate installation of foundation caissons for the two river piers and the pier at the south bank. (An outstanding American application of this method occurred on the Suisun Bay bridge of the Southern Pacific Railroad, in California, as illustrated in a step-by-step portrayal, *Construction Methods,* May, 1930, pp. 52-55.) For the two river piers, the contractor drove inclosures 29½ ft. in diameter of steel sheetpiles, at one pier using 44-ft. piles driven 12 ft. into riverbed gravel and projecting 1 ft. above high tide and at the other pier employing spliced piles 70 ft. long which penetrated 17 ft. into the sand bottom of the river. At the pier on the south bank, rectangular inclosures for the two caissons were constructed of timber sheetpiling on timber piles. The inclosures at all three piers were filled with dredged material through which the caissons were sunk.



STEEL SHEETPILE INCLOSURE is constructed to form island for cylindrical caisson of river pier.

At each of the river piers, the contractor placed the cutting edges of the cylinders on the fill and built up the reinforced-concrete walls in 6-ft. lifts as the material was removed by clamshell buckets. The caissons had external diameters of 28 ft.; internal diameters of 15 ft. When the cylinders reached a boulder formation close to rock, air locks were installed and the

OVERHEAD CABLES raise hinged arms of steel arch ribs to crown bearing. Guys from upstream and downstream points anchor steel ribs against wind sway.

caissons were sunk to final elevation and seated in bedrock by hand labor under air pressure. Similar methods were employed in the rectangular caissons at the south bank.

Compressed-Air Practices—Although pressures of 35 to 60 lb. per square inch in the working chambers were required by the depth of foundations, pneumatic operations carried on continuously for 6 months produced no fatal case of caisson disease nor permanent disability in any workman. Each man worked two shifts in 24 hr., the duration of the shift in the working chamber being 2 hr. in the shallower foundation at the south bank and 1½ hr. in the deeper excavations for the river piers. The men were locked in at the rate of 2 lb. per minute, and a graduated scale of decompression was followed in locking them out. Decompression to half the working pressure proceeded at the rate of 2 lb. per minute, the next 5 lb. at 1 lb. per minute, the following 5 lb. at ½ lb. per minute, and final decompression to atmospheric pressure at the rate of ⅓ lb. per minute. The decompression period lengthened appreciably as the working pressure increased. A medical officer was attached to the contractor's staff, and all cases of caisson disease were treated in a medical lock placed at the doctor's disposal.

Each pair of pier shafts is connected at the surface with a reinforced-concrete beam, faced with granite. These beams measure 96 ft. long, 20 ft. wide and 9¾ ft. deep, extending from a depth of 1½ ft. below low tide to 3 in. above high tide. After completing the sealing and concreting of the foundation caissons at the river piers, the contractor constructed these beams in-

SUSPENDED COFFERDAM at pier in background permits casting of concrete beam connecting caisson shafts in dry. Timber piling to support similar cofferdam has been driven at pier in foreground.

side watertight boxes supported by temporary timber piles. The heads of the cylindrical shafts protruded through the floor of each box, in which the reinforced concrete beam was cast in the dry.

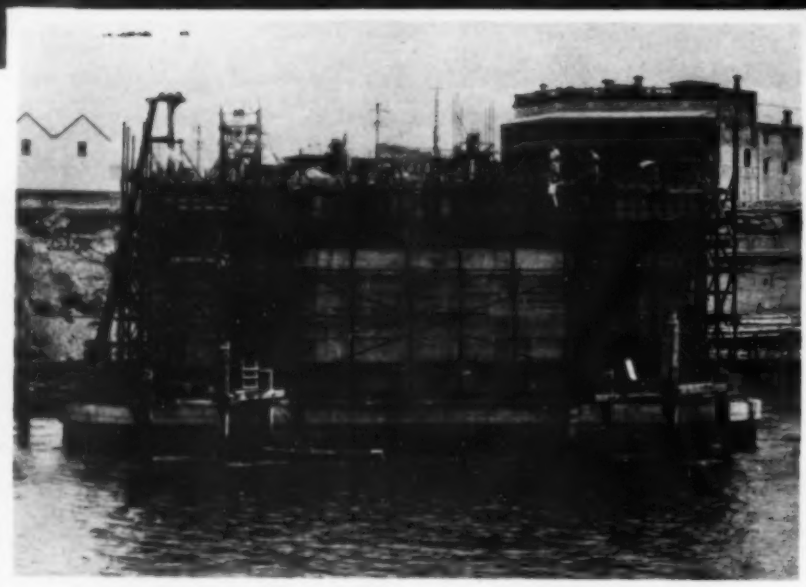
Foundations of the pier at the south end of the 92-ft.. arch on the south bank of the river were constructed by sinking eight open caisson cylinders through 85-ft. of water-bearing mud, sand and gravel. The walls of these cylinders, 7 ft. in outside diameter, could be made only 11 in. thick, as an interior diameter of 5 ft. 2 in. was required to permit dredging with clamshell buckets. In spite of the thin walls, the caissons sank under their own weight to about half the required depth, and sinking was completed under loads of 100 to 130 tons on each cylinder.

Arch Construction—Reinforcing for the ribs of the three river spans consisted of three-hinged steel arches erected as cantilever arms. The steel arch ribs were shipped to the site in sections weighing up to 11 tons each. After mounting the first section of each arm on the hinge pin at the pier, the erectors progressively connected the other four sections, supported on temporary timber staging near the water level. When all sections were in position, the two halves were raised to the proper level at the crown by means of overhead cables. During and after erection, the steel arch ribs were guyed from upstream and downstream points on the axes of the hinge pins. These guys served as windbracing during construction. The arches were completed by hanging formwork from the steel ribs and incasing them in concrete.

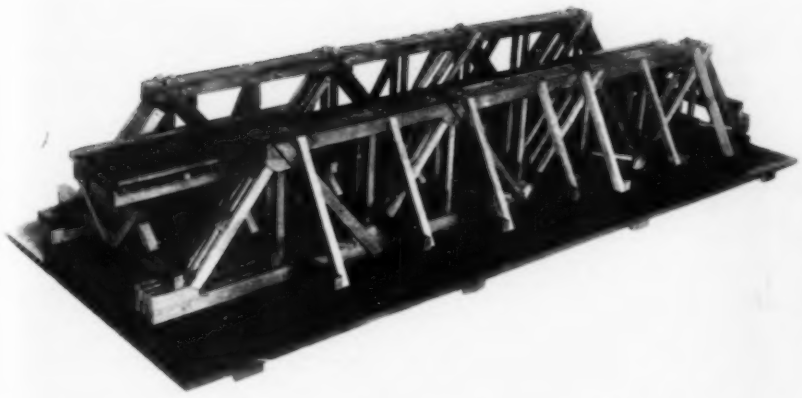
A floor system of structural steel cross girders and stringers, incased in gunite, carries a reinforced-concrete deck slab. The roadway is paved with asphaltic concrete.

Administration—A. E. Harding Frew, consulting engineer, of Brisbane, designed the bridge and supervised its construction. For M. R. Hornibrook, Ltd., of Brisbane, the contractor, M. R. Hornibrook was managing director and G. O. Boulton was chief engineer.

CYLINDRICAL CAISSONS for pier foundation are sunk in artificial islands by open-dredging through central wells until cutting edges reach boulder formation.



PIER SUPERSTRUCTURE is erected above reinforced-concrete beam faced with granite masonry.

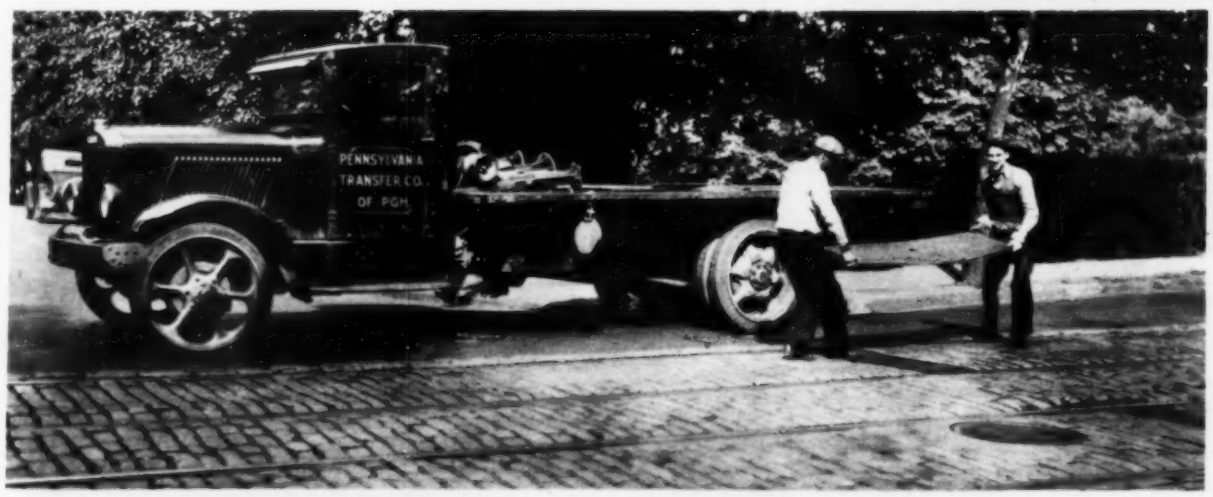


BRIDGE MODEL on scale of 1 to 12 aids Hart Construction Co., of Tacoma, in framing and erecting 80-ft. span all-timber trusses for logging railroad of Weyerhaeuser Timber Co. in Washington. Special design utilizes Tuchscherer type of split-ring dowel, employed extensively in Germany for connecting truss members. Truss model permitted detail study of ring-connected joints.

JOB ODDITIES

A Monthly Page of Unusual Features of Construction

MODERN ATLAS bears weight of 69-story skyscraper on his shoulders. Colossal figure, carved in stone by Lee Lawrie, surmounts doorway of new RCA Building in Rockfeller Center, New York City.
Wide World Photo



IN ADVANCE OF 60-TON MONOLITH *(left)* being hauled to Mellon Institute of Industrial Research, Pittsburgh, Pennsylvania Transfer Co. places steel-plate protection across cast-iron drainage inlets and manholes to prevent breakage. Truck with steel plates precedes each of 62 limestone columns on trip from railroad yard to building and picks up plates after passage of load. Columns are erected by Alexander Howie, Inc., as described on pp. 36-39 of this issue.

NAIL-DRIVING CONTEST. Members of General Contractors Association of New York City, on recent annual outing, go a step further than getting down to brass tacks. Instead, they hammer home real spikes in competition won by Jack O'Keefe for whom a cigarette case donated by E. L. Stanton, general manager of the association, was the reward for hitting the nail on the head.

Step-by-Step Field Methods

Cement-Bound Macadam

TO ASSIST engineers and contractors in obtaining efficiency and economy in the design and construction of cement-bound macadam, the Portland Cement Association has built an experimental road of this type near Elmhurst, Ill., just west of Chicago. Sixty test sections are included in a road 1,200 ft. long.

The principal objective of this test is to develop and demonstrate design and construction practices that will permit cement-bound macadam to be used efficiently. Crushed stone, slag, and gravel are used in the various test sections, with grout of varying consistencies. Included with many tests, will be the effect of vibration, as compared with rolling, in procuring compaction and thorough penetration of the pavement.

The construction procedure here illustrated covers one of three major investigations—construction by rolling. On other sections the longitudinal float is the only equipment used for consolidating the grout and coarse aggregate. A third method covers the use of vibrators mounted on longitudinal floats of heavy and light construction or on a platform or sled about 3 ft. square.

Investigations also cover the ease of penetrating stone, gravel and slag of different sizes with sands of various degrees of fineness.

1 COARSE AGGREGATE is first weighed and placed by hand to permit accurate void determinations. It is then rolled two times over with a 5-ton tandem roller. Contour of stone before rolling is a determining factor in final smoothness.

2 SAND AND CEMENT are mixed in a two-bag mixer with enough water to give a consistency of thin cream. Too much water causes sand and cement to separate. Too little water prevents penetration. Two-row bristle brooms are used to control grout distribution. Special spout drops grout on coarse aggregate in small streams without displacing coarse aggregate.

3 TEST HOLES are dug in coarse aggregate ahead of grouting. Successful penetration is evidenced by grout appearing in the *bottom* of the test hole ahead of grouting. Successful penetration is obtained at the time of grouting. Rolling or tamping does not assist penetration.

4 GROUTED COARSE AGGREGATE is rolled with a 5-ton tandem roller 30 or 45 min. after grouting. At this time very little free water is flowing from the surface and the grout has stiffened considerably because of lowered water content. Rolling is continued for three or four trips or until the cement-bound macadam becomes quaky and takes on the characteristics of mixed concrete.

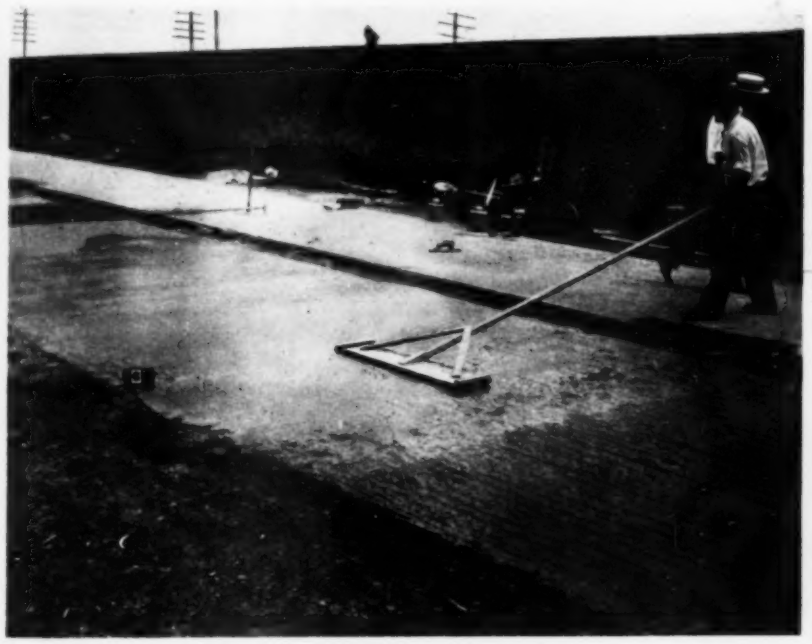
White Cement Inlay Forms

TRAFFIC STRIPE

PERMANENT traffic guide stripes of white cement, inlaid in freshly concreted pavement by a new continuous machine process, have been incorporated as an integral part of the paved surface of Figueroa St., Los Angeles. The inlaid center stripes, aggregating about a mile in length, are 10 in. wide and 1¼ in. deep.

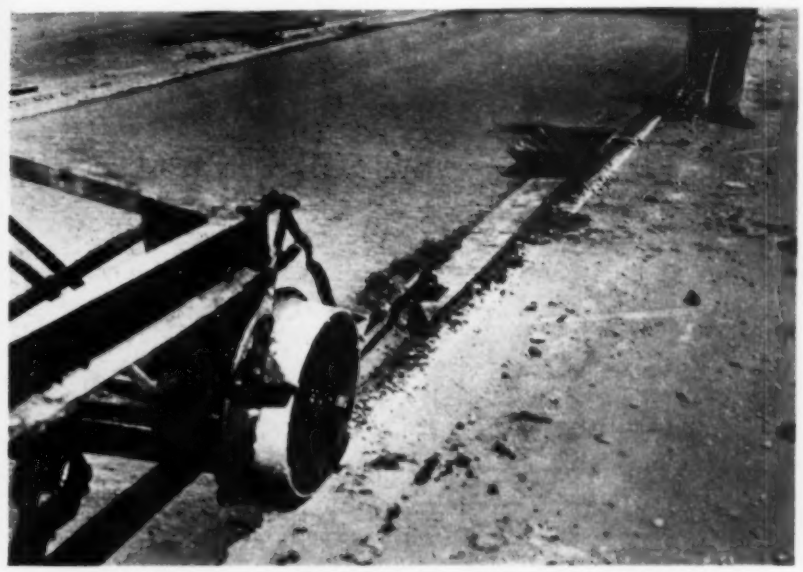
On this project J. J. Jessup, city engineer of Los Angeles, reports that the contractor elected to build the white stripes with the Gibbs inlay marking machine, a device developed by C. H. Gibbs, of Long Beach, Calif. The machine, as illustrated herewith, consists of a small chilled steel plow pulled along behind the concrete finishing machine. Behind the plow are four short, jointed steel slabs to form a 10-in. wide groove in the concrete which is filled with white cement mortar from a hopper riding behind the last steel slab. At the rear end of the hopper hollow smoothing pans finish off the surface of the stripe which is protected by cover pans during final finishing operations on the adjacent pavement slab. When the cover pans are removed the stripe is smoothed up with edging tools, forming a permanent guide of high visibility.

5 ROADWAY IS TAMPED with a longitudinal float about 20 min. after rolling. This takes out the larger surface irregularities left by the roller. Note that weight of the men is not great enough to more than mark the surface. Bridges are not needed.

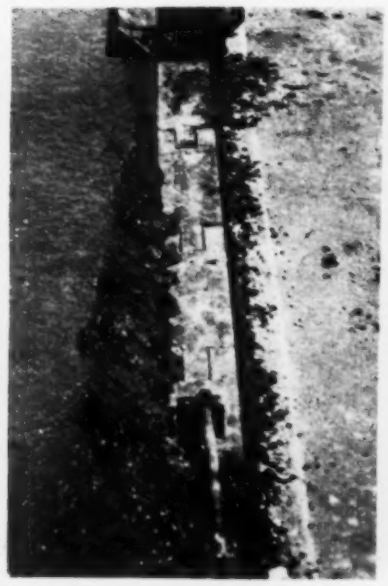


6 FINAL FLOATING wipes out the marks left by the longitudinal float and those left by the men. Any excess grout remaining is also wiped from the surface.

7 FINISHED SURFACE TEXTURE is obtained by light brooming. The desired surface has only a thin coating of grout over the coarse aggregate. Edges and joints are tooled according to standard practice.



GROOVE in concreted slab is formed by plow, pulled behind finishing machine, and followed by flat steel slabs (jointed to pass around curves) carrying at rear hopper for white cement mortar.



TRENCHER DETAILS, showing plow face on front end, articulated steel slabs to form 10-in. wide groove and cement hopper, at rear.

WHITE CEMENT is inlaid in groove from hopper trailing behind plow. At rear, cover pans protect white stripe.

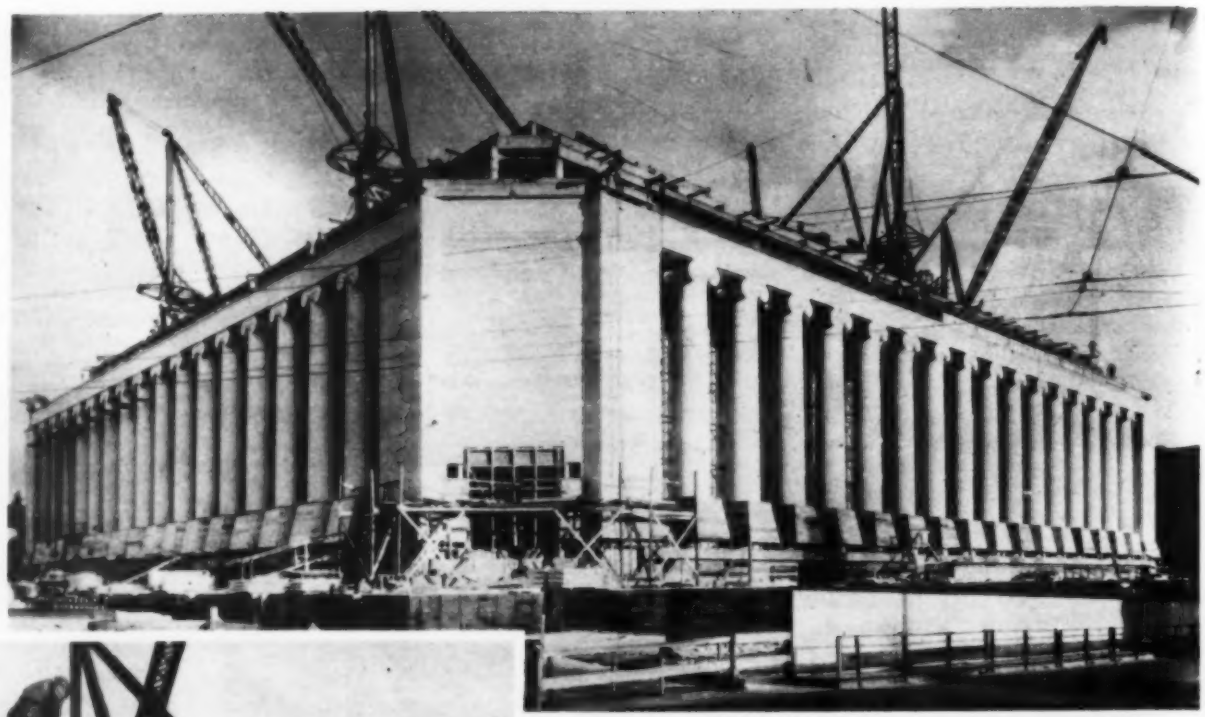
Mobile Gantry Crane Erects

60-TON COLUMNS

A MOBILE gantry crane of special design erected 62 monolithic limestone columns weighing 60 tons each in 29 working days at the new Mellon Institute of Industrial Research, Pittsburgh, for Alexander Howie, Inc., of Cleveland, stone-setting subcontractor under the Mellon-Stuart Co., which holds the general contract for the building. During the latter part of the work, the erection crew attained a speed that enabled it to place regularly four columns a day, two in the morning and two in the afternoon. These columns are believed to have established a new record for weight of pillars erected as monoliths. The equipment designed to place the columns marks a new development in stone-setting practice.

Monolithic columns for the Mellon Institute, 36½ ft. high, 5 ft. 10 in. thick at the base and 5 ft. 4 in. in diameter at the top, were quarried and machined at Bedford, Ind., by the Indiana Limestone Co. The columns were shipped by rail to a freight yard about 1½ mi. from the building site,

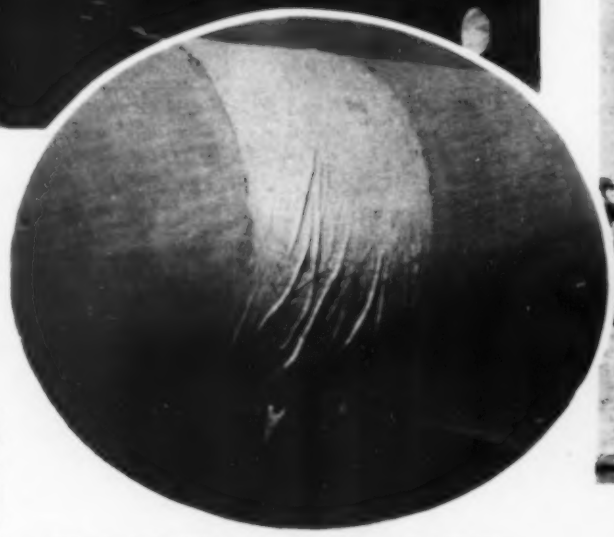
Wide World Photo



1 CONTINUOUS COLONNADE OF 60-TON MONOLITHS on four porticoes of Mellon Institute of Industrial Research presents difficult erection problem to stone-setting contractor.

2 AT RAILROAD YARD, 60-ton column is rolled from flat car to platform and from platform to truck and trailer by means of hemp ropes wound around stone and connected to double-and-double blocks operated by steam hoist. Two ropes pull column forward; third, at center of stone, acts as snubbing line to prevent too rapid movement.

where they were rolled to an unloading platform and thence to a truck and trailer. With the column in this position, workmen stripped off a wrapping of tough, waterproof paper and installed two lead-lined cast-steel bands on canvas protecting strips, after determining the correct locations of the bands by measurement along the col-



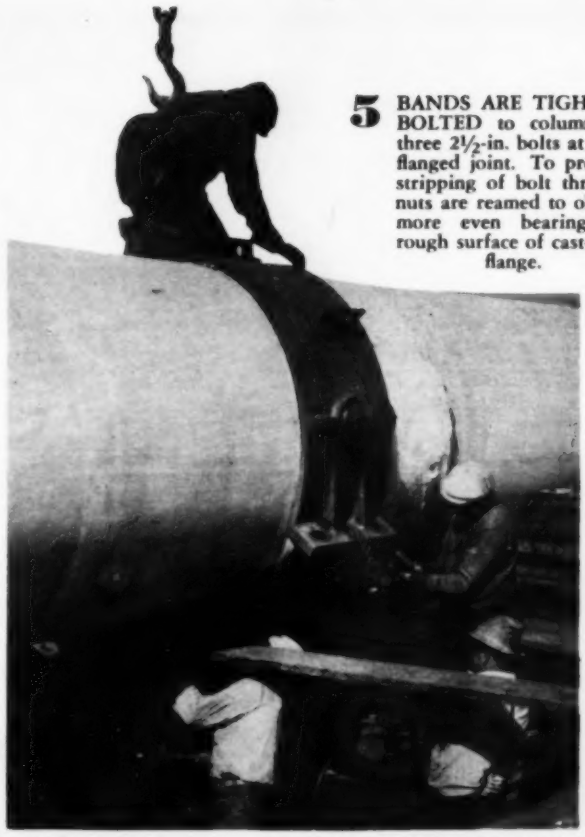
3 AFTER REMOVING WATERPROOF PAPER COVERING from monolith, workmen tie canvas strip around column at each of two points where they will bolt on lead-lined cast-steel bands to be used in erection at building.

4 SEMICIRCULAR CAST-STEEL BANDS weighing 1,800 lb. per segment are placed around column in approximate position for bolting. Detailed measuring to locate bands accurately on column precedes placing of bands and bolting. Bands are lined with ⅛-in. thickness of lead anchored into ⅜-in. grooves in iron.

umn. The bands, manufactured by the Bedford Foundry & Machine Co., of Bedford, Ind., in accordance with the contractor's design, consisted of an upper band 21 in. wide and a lower band 16 in. in width. When tightened on the column by drawing up with bolts, the lead and canvas grip of the two bands was more than sufficient to support the weight of the column. Two 2½-in. rods connected the upper and lower bands. The Pennsylvania Transfer Co. hauled the columns from the freight yard to the building.

Gantry Crane—At the building, a traveling gantry crane lifted each column from its truck and trailer, with the assistance of one of the six stationary steel stone-setting derricks on the job, and placed it on its base. One rail of the gantry traveler consisted of a 15-in. 85-lb. beam placed on top of the exterior row of steel columns of the building; the second rail rested on a support of timber cribbing constructed about 35 ft. from the edge of the stylobate, or broad step, on which the columns were placed. A structural steel A-frame with 21-in. I-beam legs formed the outer supporting member of the gantry. To take care of variations in ground level on the four sides of the building, this A-frame was made adjustable as to height, the difference in elevation between tops of rails being fixed at either 67 ft. 5 in. or 72 ft. 5 in. The movable hoist carriage of the gantry traveled on two 36-in. 300-lb. girders 67 ft. long which, at the inner end, framed into a truck running on the upper rail and, at the outer support, rested on rocker plates on top of the A-frame (to allow for variations in track level on the timber cribbing). Holes were drilled at several points in the bottom flanges of the 36-in. girders to permit adjustment in the length of the gantry span. On this work, the longest span, between upper rail and top of A-frame, was 54 ft.

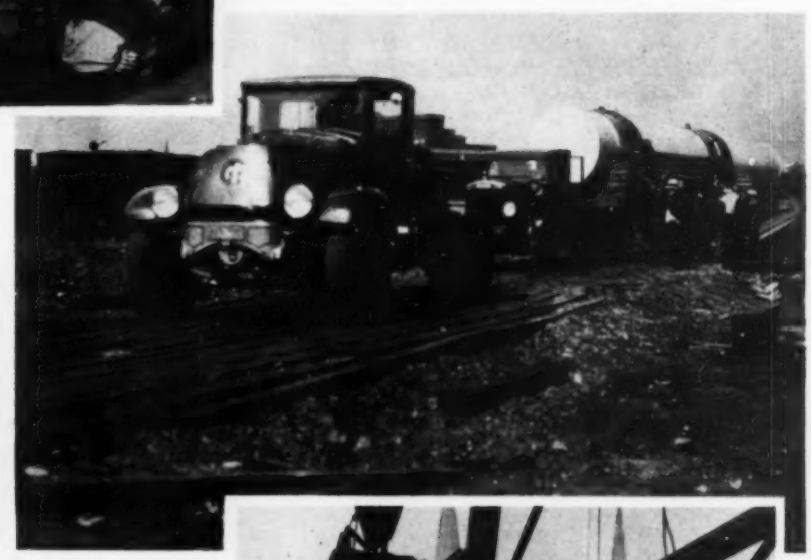
Power to lift the heavy columns and to move the hoist carriage along the gantry girders was supplied by a Thomas 3-drum hoist driven by a 125-hp. G.E. motor. To hoist the columns, the contractor used thirteen parts of 1-in. wire rope reeved through Upson Walton 80-ton roller-bearing blocks. The two remaining drums of the hoist engine were utilized to move the carriage along the girders, a ⅝-in. cable from each drum being reeved through three-sheave blocks to shift the carriage in one direction. Two hand winches, one mounted on the girders above the upper rail, and the other at the base of the A-frame, were used to move the gantry traveler itself, lines to the two

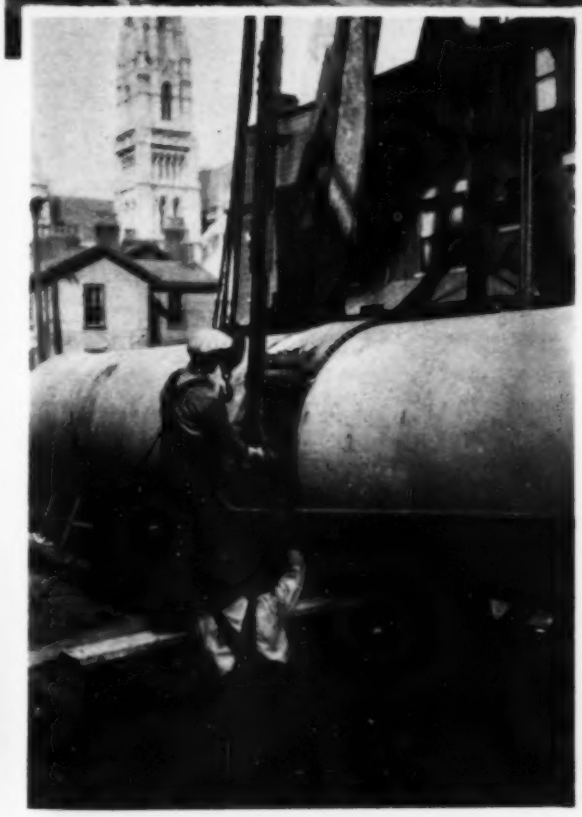


5 BANDS ARE TIGHTLY BOLTED to column by three 2½-in. bolts at each flanged joint. To prevent stripping of bolt threads, nuts are reamed to obtain more even bearing on rough surface of cast-steel flange.

6 TENSION EYEROD 2½ in. in diameter on each side of column connects cast-iron bands. Eye of rod fits over pinion on upper band, centered 21 ft. 2 in. above bottom of column, more than 3 ft. above center of gravity. Lower band is centered 3 ft. 5 in. above base. Column is lashed to vehicle frame with steel cables.

7 ADDITIONAL TRACTOR TRUCK *(below)* loaded with 6 tons of pig iron pulls second truck by wire rope hauling line on 1½-mi. trip to building. Police escort on motorcycles keeps street clear for slowly moving load. Steel plates laid over manholes in advance protect cast-iron covers.





8 AT BUILDING, after taking off cable lashings, workmen temporarily remove eyes of tension eyerods from pinions on upper band to permit connection of adjustable eyebars suspended from yoke on hoisting block of gantry crane.

9 WITH EYEBARS AND EYERODS pinned securely on pinions, workmen place wire-rope loop attached to hoist block of auxiliary derrick over lower end of column, protecting stone from damage by belt of wood blocks.

10 SIMULTANEOUS HOISTING by gantry crane and by derrick lifts monolith in horizontal position clear of bolsters, permitting truck to drive ahead.

winches being wound on the drums simultaneously.

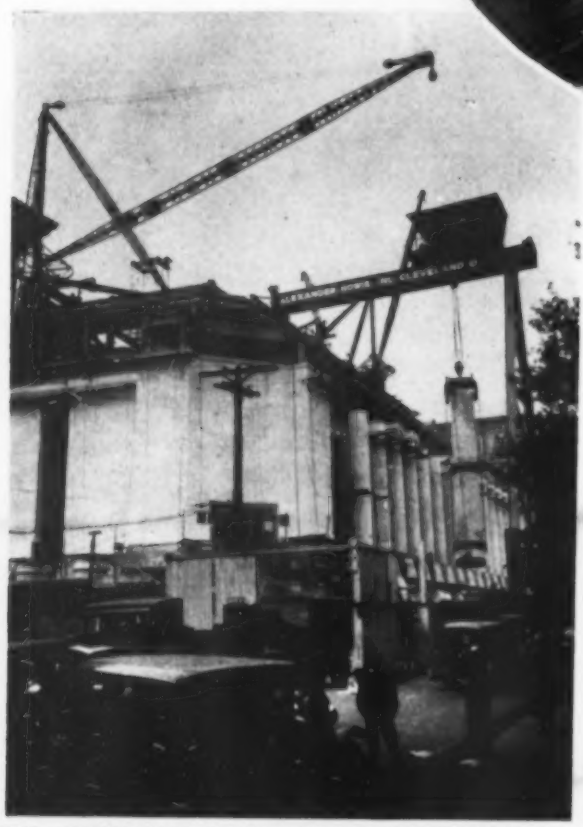
Erection Procedure—Because of the great weight imposed on the structural frame of the building by the gantry crane when placing a column, it was necessary to center the gantry over one of the steel columns of the structure. The gantry was securely anchored against movement at right angles to the building facade by turnbuckle ties and substantial timber bracing placed between the inner ends of the girders and the structural steel frame of the building.

When a column had been brought in by truck and trailer on a special timber roadway under the gantry crane, eyebars suspended from the hoisting falls of the gantry were lowered and connected to pinions on the upper cast-steel band, which was several feet above the center of gravity of the column. A hoisting line from one of the stationary steel derricks was attached to the lower end of the column, and the two machines raised the monolith simultaneously in horizontal position. After the truck had driven ahead, the column was allowed to revolve slowly on the pinions to vertical position, with the line from the derrick controlling the speed of rotation. The gantry crane then moved the column slowly to the portico.

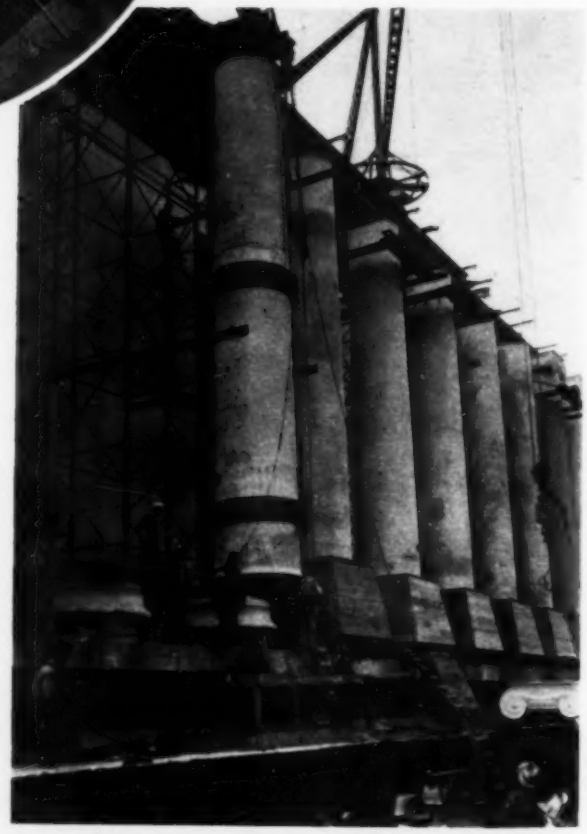
11 AS GANTRY CRANE CONTINUES TO HOIST MONOLITH, column slowly revolves to vertical position, line from derrick controlling speed of rotation and preventing overloading and distortion of crane.

14 THREE-DRUM HOIST driven by 125-hp. electric motor operates hoisting falls and two traveling motions of carriage on gantry tracks. End of gantry on building is centered over steel column and is securely anchored by turnbuckle ties and timber braces. Hand winch on top of gantry frame is used in conjunction with another winch at base of A-frame leg to move entire gantry horizontally. Wheels of gantry are guided between flanges of angles bolted to I-beam rail.

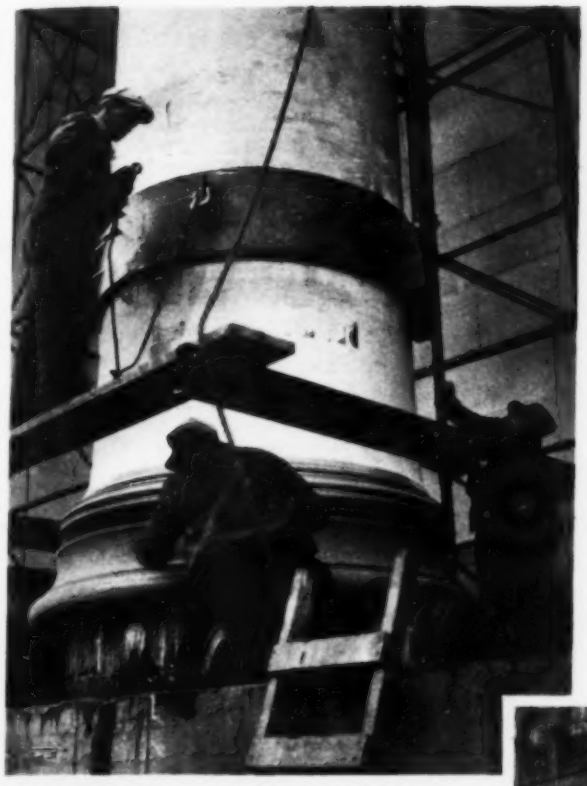
Limestone columns of the porticoes rarely were directly in line with the structural steel columns of the building, and it usually was necessary to draw the stone column to one side of the gantry for erection. The greatest displacement required at any point was 2 ft. 1¾ in. To drift the stone columns this or a lesser distance, the subcontractor hooked up a block and tackle to the hoisting block of the gantry and pulled the column as far as required by a line to a derrick hoist. Because of the short length of gantry hoisting falls available when the stone columns were in raised position, this drifting operation presented some difficulty and called for time and care in centering a column on its base.



12 WITH COLUMN SUSPENDED VERTICALLY BETWEEN EYEBARS, erectors detach wire-rope loop from lower end, and crane moves massive stone toward final position on base.



13 BECAUSE GANTRY IS CENTERED OVER STEEL COLUMN, monolith is off center when moved over base, requiring displacement in this instance of 1 ft. 4 in. away from last column erected. Column is drifted this distance by means of block and tackle attached to lower block of hoisting falls and operated by derrick hoist line.

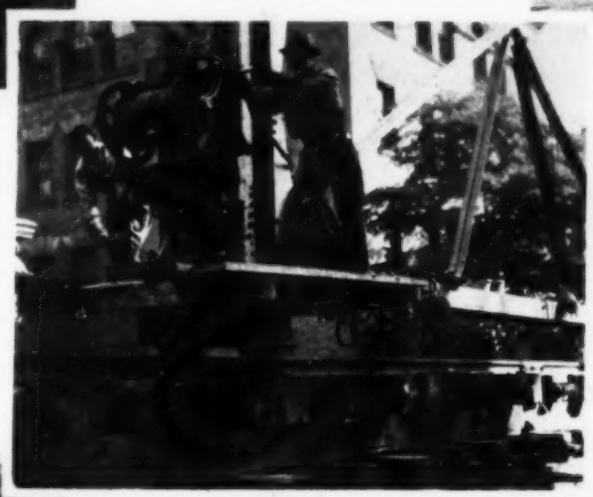


15 WITH COLUMN DRIFTED TO CORRECT POSITION OVER BASE, crane slowly lowers it on lead and mortar joint. Column then is checked for vertical alignment by plumb lines from top.

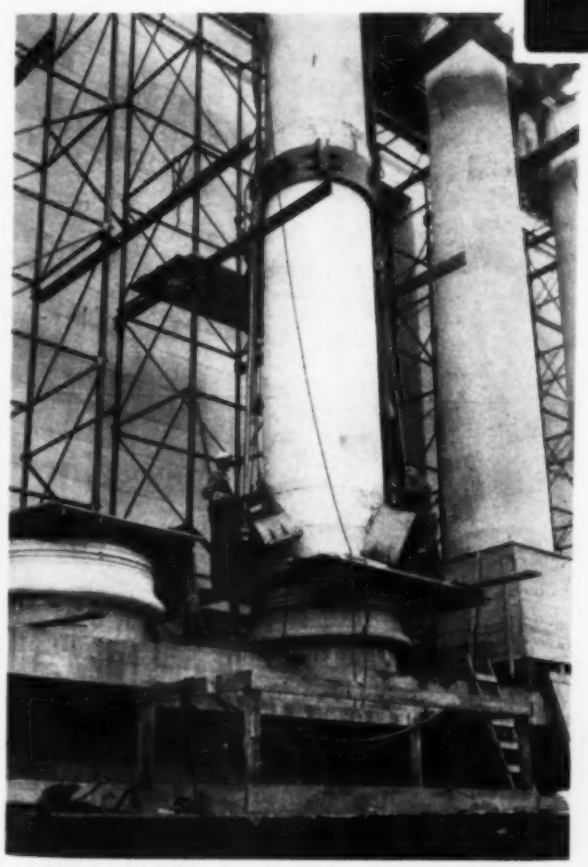
Timber Roadway—No special problem was presented by the construction of a temporary roadway at the railroad yard, where the ground was fairly solid and where it was necessary to do little more than lay planks. At the building, however, fresh backfill afforded no solid foundation, and the subcontractor was compelled to utilize as a support for the roadway a line of steel sheetpiling which the Mellon-Stuart Co. had left in the ground about 3 ft. clear of the stylobate wall to take care of the architect's drainage system. Because of the variation in grades around the building, the top of the sheetpiling was from 4 to 8 ft. below the sidewalk level.

As a direct support for the roadway, the contractor erected on the line of steel sheetpiling a row of 12x12-in. timber uprights spaced several feet apart. To keep these timber columns from splitting and to hold them on the sheet piling, a ½-in. steel plate and two 4x5-in. angles were bolted in the lower end. The tops of the timbers were cut off 12 in. below sidewalk grade, and a 12x12-in. beam was laid on the tops of the uprights. After grading the backfill level with the top of this beam, the subcontractor laid a solid foundation for the timber roadway with the beam as one bearing and the solid earth beyond the backfill as the other bearing. The foundation for the roadway took about four carloads of timber, and the roadway itself on each side of the building required about five carloads.

17 DUAL CONTROL SYSTEM assures uninterrupted receipt of signals by hoist engineer during delicate operation of setting column. A. J. STANLEY, rigging foreman, uses telephone to communicate with operator and holds electric push button in left hand to give bell signals in case of failure of telephone system.



18 TO MOVE GANTRY CRANE to position for erecting next column, workmen operate hand winches at lower and upper rails, winding steel pulling cables on drums. Note plates and angles bolted to ends of timbers which have been used to support roadway from steel sheetpiling.



16 BANDS ARE REMOVED from column and are loaded with eyerods on to truck by gantry crane. Column then is ready for placing of capital.

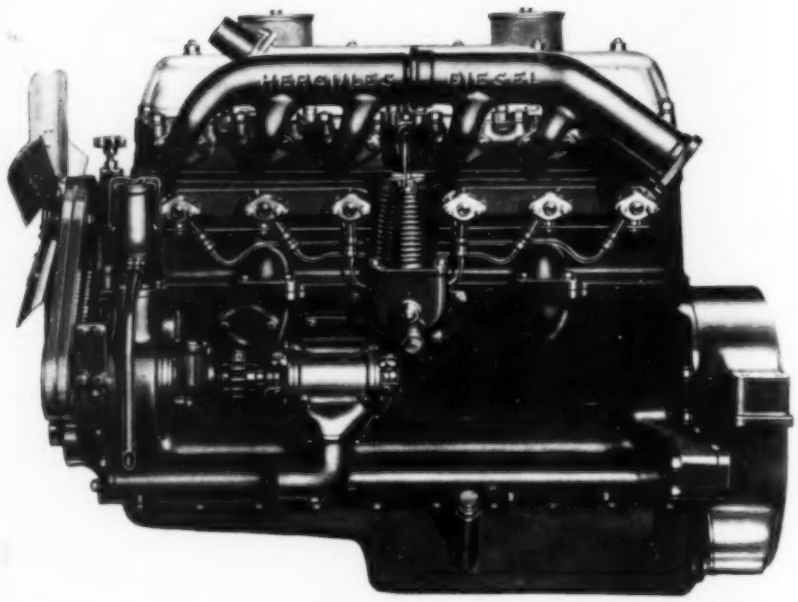
Progress—Daily reports of Alexander Howie, Inc., record that the first column was set Sept. 9, 1932, and the last Oct. 26, 1932, giving a total elapsed time of 1½ months. Columns actually were erected in 29 days. During the 1½ months, the gantry and roadway were dismantled and erected three times. The first erection and final dismantling are not included in the 1½ month period.

Supervision—Under Alexander Howie, president of the firm, erection of the columns was directed by Alex Ewan, general superintendent, C. M. De Croes, job superintendent, and A. J. Stanley, rigging foreman. George Merts, engineer for Alexander Howie, Inc., designed the gantry, which was built by the American Bridge Co. Janssen & Cocken, of Pittsburgh, are architects of the building, and the Mellon-Stuart Co., of the same city, is general contractor.

19 BECAUSE OF DIFFERENCES IN ELEVATION of ground surrounding building, A-frame of gantry crane provides 5-ft. adjustment in height, distance from top of lower rail to top of upper rail being either 67 ft. 5 in. or 72 ft. 5 in. Lower rail is supported on cribbing to height of 7 or 8 ft. above ground.

HYDRAULIC HOIST and one-man spout designed especially for Rex Moto-Mixer *(left)*. Jackass hoist is fitted to rear end of truck chassis and raises discharge end of drum approximately 8 ft. above ground permitting concrete to be chuted over an area about 75 per cent greater than would be possible otherwise. With this unit sidewalks can be poured across parkways without wheeling and building foundations and walls can be chuted with truck 10 to 20 ft. distant from hole. One-man spout rides beside drum replacing one fender when Moto-Mixer is traveling and may be swung out of its cradle into position by one man who hooks supporting rod and has it ready to pour in less than 1 min. These improvements on Moto-Mixer make it particularly adaptable for small paving and sidewalk jobs.—Chain Belt Co., Milwaukee, Wis.

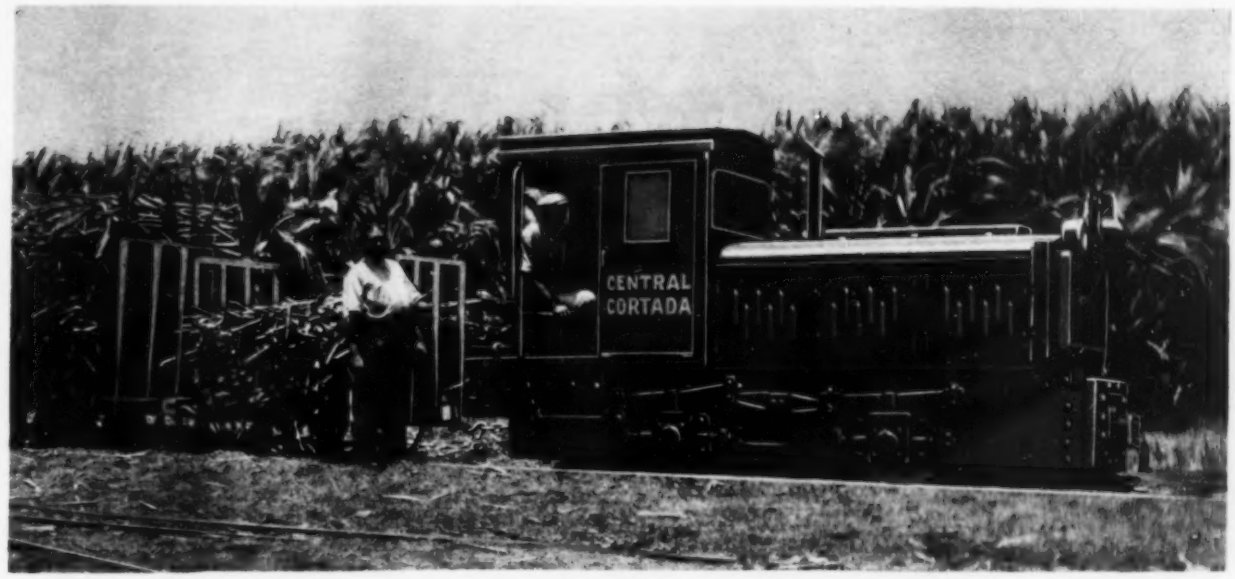
NEW EQUIPMENT *on the Job*



FULL DIESEL ENGINE of 6-cylinder, solid injection, high compression type with 5-in. bore and 6-in. stroke constructed to operate at speeds up to 2,000 r.p.m. for automotive, industrial, oil field and marine purposes. Will develop 100 hp. at 1,000 r.p.m. to 177 hp. at 1,800 r.p.m. and 188 hp. at 2,000 r.p.m. Fuel consumption is .383 lb. per brake horsepower per hour at 1,000 r.p.m.; .430 lb. at 1,800 r.p.m. and .46 lb. at 2,000 r.p.m.—Hercules Motor Corp., Canton, Ohio.

2-YD. SHOVEL *(left)* powered by 4-cylinder 8x9-in. gasoline engine, a heavy-duty power plant operating at slow speed especially adapted to rock digging. Boom and dipper sticks of all welded construction. Boom slightly cambered to make possible maximum operating ranges. "Cushion clutch" on hoist drum transmits full engine power, but reduces overload shocks 50 per cent. Engine drive gears, mounted on ball and roller bearings and run in bath of oil, have helical cut teeth. "Feather-touch" control shifts main clutches, the operation of which depends on pressure of operator's hand on lever.—Northwest Engineering Co., 28 E. Jackson Blvd., Chicago, Ill.

10-TON DIESEL POWERED LOCOMOTIVE has 6-cylinder power plant of solid injection type with 4⅞-in. bore and 6-in. stroke developing 95 hp. at 1,200 r.p.m. Equipped with mechanical gear drive in sizes from 6 to 60 tons and diesel-electric drive in sizes from 25 to 60 tons. Incorporation of 4-speed transmission makes it possible to apply same power and speed in either forward or reverse movement. Side and end frames of Plymouth chassis made of extra heavy steel to insure perfect alignment. Semi-elliptic springs are both side and cross equalized to insure easy riding over rough and uneven track, practically eliminating any possibility of derailment. Cabs and canopies of heavy-gage sheet steel fully inclosed.—Fate-Root-Heath Co., Plymouth, Ohio.



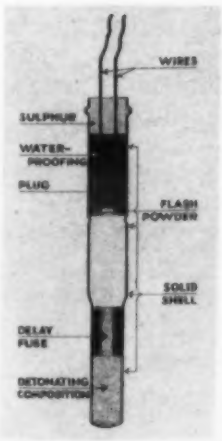
If You Want Further Information—

Within the space limits of this page it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them.

LIGHT-DUTY SPRAY GUN *(left)* for use with small low capacity air compressing equipment. Useful for maintenance painting of residences, stores, hotels, theaters and public buildings. Three air caps furnished: one for round spray; one for fan spray, and one for angle spray for floor and ceiling painting. Operation at maximum capacity requires only 2 cu. ft. of air per minute. Fan or angle caps will spray a maximum of ¾ to 1 pint of material per minute and produce spray 6 to 10 in. wide at normal working distance. Sprays light and heavy material with equal facility. Full-grip handle is one piece aluminum casting with brass inserts at fluid and air connections. Either standard air valve or bleeder valve furnished.—The DeVilbiss Co., Toledo, Ohio.

POWER-OPERATED CONTROLS for Adams heavy-duty leaning wheel grader *(below)*. Power, supplied by 6-hp. single-cylinder air-cooled gasoline engine mounted in grader frame, is transmitted to control box immediately in front of operator where series of heat treated gears inclosed in dirt-proof box and running on anti-friction bearings transmits power to various control shafts. Control levers operate steel jaw clutches which release automatically when extreme of any adjustment is reached. Independent lever for each adjustment.—J. D. Adams Co., Indianapolis, Ind.



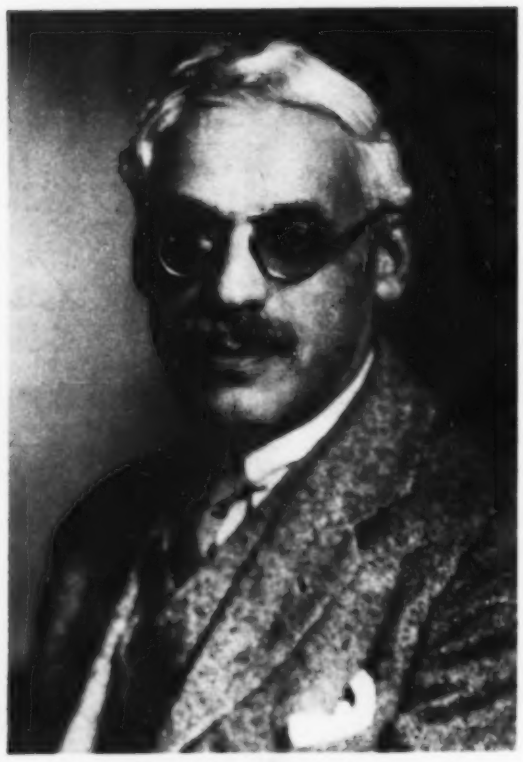
ALL-METAL DELAY ELECTRIC BLASTING CAP with firing and delay elements that produce practically no gas when burning and make possible use of solid, one-piece ventless shell. Absence of gas precludes danger of ignition of dynamite and the necessity of providing gas-escape openings through which moisture might enter and cause misfire.—Hercules Powder Co., Wilmington, Del.

Present and Accounted For —

A Page of Personalities

NRA CONSTRUCTION ASSISTANT. Malcolm Pirnie, consulting engineer, of New York City and president of the American Waterworks Association, was appointed last month to serve at Washington, D. C., as assistant to Deputy Administrator Malcolm Muir of the National Recovery Administration on matters relating to general construction and building. He is acting, also, as coordinator between the NRA and the Public Works Administration.

Blank & Stoller Photo

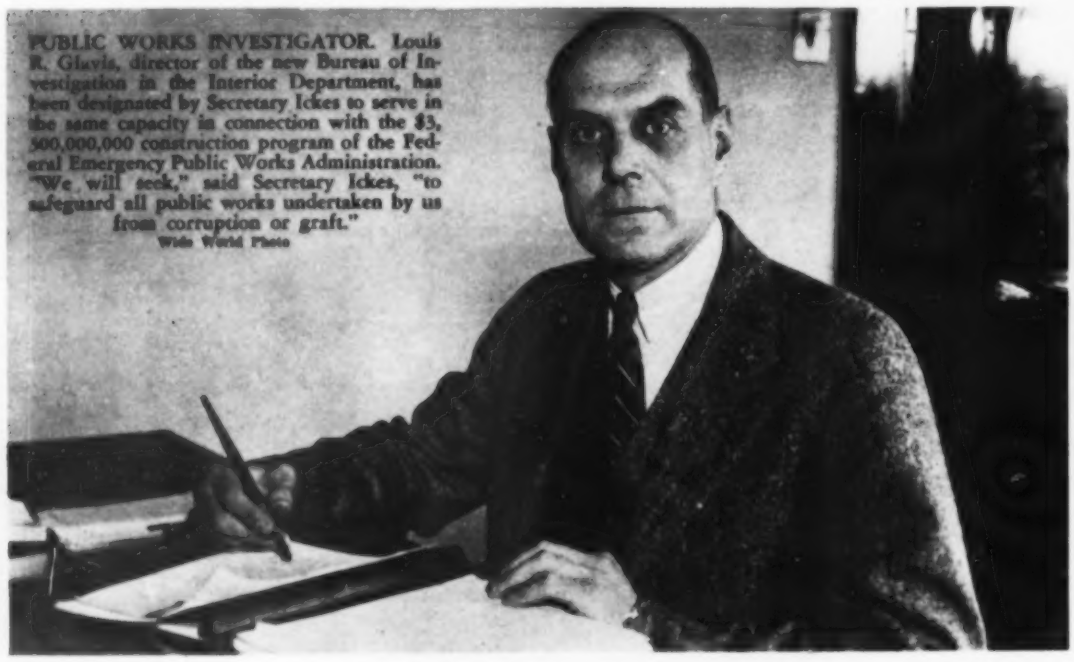


NRA HOUSING CHIEF. Robert D. Kohn, architect, of New York, past-president of the American Institute of Architects and former chairman of the Construction League of the United States, has been placed in charge of the newly created Housing Division of the Public Works Administration at Washington, D. C. For approval under the Recovery Act the administration has adopted a housing policy favoring low buildings on low-cost land and against the creation of what Mr. Kohn described as new "vertical slums".

Marceau Photo

CODE COMMITTEE CHAIRMAN. Stephen F. Voorhees, architect, and member of the firm of Voorhees, Gmelin & Walker, of New York City, has been serving as chairman of the Code Committee of the Construction League of the United States, which has drafted and submitted to the NRA at Washington, D. C., a master code of fair competition for the construction industry.

Underwood & Underwood Photo



PUBLIC WORKS INVESTIGATOR. Louis R. Glavis, director of the new Bureau of Investigation in the Interior Department, has been designated by Secretary Ickes to serve in the same capacity in connection with the $3,300,000,000 construction program of the Federal Emergency Public Works Administration. "We will seek," said Secretary Ickes, "to safeguard all public works undertaken by us from corruption or graft."

Wide World Photo

PWA STATE ENGINEER. Arthur S. Tuttle, consulting engineer and former chief engineer of the Board of Estimate and Apportionment of New York City, has been appointed by the Federal Public Works Administration of the NRA to be state engineer for New York. Mr. Tuttle, a former vice-president of the American Society of Civil Engineers, has been active in unemployment relief work as a member of the Mayor's committee of five. He has also served as consultant to the Citizen's Budget Committee.

Wide World Photo

BREAKS
PAVEMENTS
ROCK
CONCRETE
FROZEN EARTH
CASTINGS
WALLS

Announcing

another New KEYSTONE Shovel Utility

Demolition HAMMER

AGAIN Keystone pioneers by bringing out another strikingly new and important shovel utility: the powerful Demolition Hammer, attached to the end of the Keystone Model 18 combination Plunger and Trench Shovel boom. (The change requires only two hours.) ¶ The hammer head is removable and may be replaced with tools of different shape, such as pick, mattock, axe, hoe, ball pien, etc., to suit requirements of different jobs. ¶ This is the third shovel utility introduced and perfected by Keystone: The first was the Skimmer, now developed into a full-revolving Plunger Shovel for highway grading and paving work. The second was the Trench Shovel or Pullscoop. Both these utilities proved so highly successful that most other convertible shovel manufacturers in recent years have been forced to adopt them. Only Keystone makes the genuine, perfected through 20 years of extensive experience. ¶ Catalogs and further information about the distinctly new and different Keystone No. 18 full-revolving shovel, with four utilities on one boom, sent on request. Keystone Driller Company, Beaver Falls, Pa. (Established 1882.) Branches: Arlington, N. J.; Birmingham, Ala.; Waukegan, Ill.; Joplin, Mo.

KEYSTONE 18

DIPPER SHOVEL • PLUNGER SHOVEL • TRENCH SHOVEL • HAMMER • CRANE • DRAGLINE

What to do about a worn-out Dock-wall

J. H. Terry and Company, Philadelphia, Contractor

THE dock-wall of timber or masonry that has seen its best days and is becoming unsafe is a common problem. Repairs would be only an expensive makeshift, and a new wall of the existing type would mean a large outlay for an already obsolete structure.

The modern, the economical answer to this problem is to replace the old wall with a structure of Bethlehem (Lackawanna) Steel Sheet Piling. That is what the Florence Pipe Foundry and Machine Company did when it became apparent that the bulkhead at their plant at Florence, N. J., along the Delaware River, had about reached the end of its usefulness.

The new steel-piling wall, with a short section of the old timber wall extending beyond it, is shown in the illustration. The completed length of the new wall is 250 ft. The approximate depth of the water along the dock is from 12 to 14 ft., and the Bethlehem (Lackawanna) Piling was used in 30-ft. lengths.

After 20, 30, or more years of service a modern dock-wall built of Bethlehem (Lackawanna) Steel Piling will be as serviceable as it is today. Such a dock-wall costs less than any comparable type of construction, is strong and tight, and requires virtually no maintenance.

A large number of old dock-walls in all parts of the country have been replaced by long-lasting structures built of Bethlehem (Lackawanna) Steel Sheet Piling.

KALMAN STEEL CORPORATION

Subsidiary of Bethlehem Steel Corporation

General Offices: Bethlehem, Pa.

District Offices: Albany, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Cincinnati, Detroit, Houston, Milwaukee, Minneapolis, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, Syracuse, Washington. *Pacific Coast Distributor:* Pacific Coast Steel Corporation, San Francisco, Los Angeles, Seattle, Portland, Honolulu. *Export Distributor:* Bethlehem Steel Export Corporation, New York.

BETHLEHEM (LACKAWANNA) STEEL SHEET PILING

NRA
MEMBER
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WE DO OUR PART

How Long Should A Good Shovel Last?

THAT depends of course upon the constitution of the shovel, the character of the work to which it is put, and the care it is given.

When a machine is of heavy-duty construction, of a balanced and uniform design such as the Link-Belt, there is no question about its ability to give efficient service longer—to handle more yardage at less cost.

A Denver contractor after using a Link-Belt for 9 years, had this to say about it recently:

"All through its long life it has performed for us on all kinds and varieties of work, double-shifting on some, yet coming through every time dependably. It still runs as good as when we first bought it, and has its original engine and caterpillar treads."

Reduce your costs with the Link-Belt Shovel-Crane-Dragline. ¾ to 2½ yds. capacity, *heavy duty* built.

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SHOVELS · CRANES · DRAGLINES

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★ QUALITY ★

A Modern Three-Compartment Heltzel Bin with Automatic Dial Weighing Batcher.

A part of line-up of 8000 ft. of Heltzel Superior Lock Road Forms on the famous Mount Vernon Memorial Highway job, under the supervision of the U.S. Bureau of Roads.

A COMPLETE LINE OF

Steel Forms—For building Roads and Sidewalks. Steel Bins—Portable Batching Plants, Cement Bins, Central Mixing Plants, Rectangular, Square or Circular Bolted Bins, Batchers and Scales. Mechanical Spreader and Surfacer, Road Joint Installing Machines, Finishing Tools and Miscellaneous Equipment. Forms for Manhole, Sewer and Tunnel. Steel plate Construction. Special Equipment.

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WARREN, OHIO

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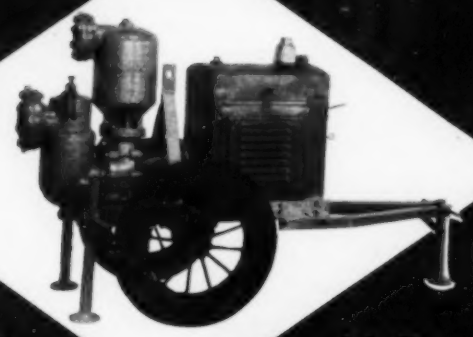
SIMPLE RELIABLE



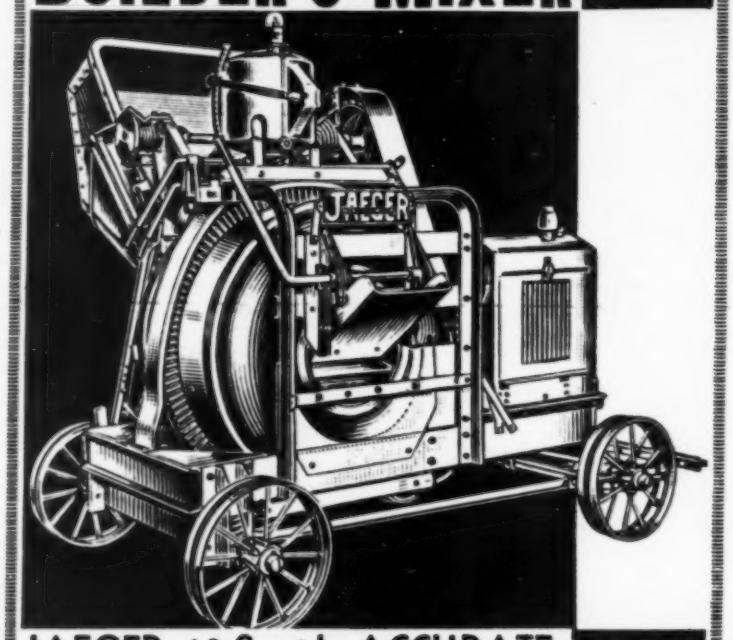
NO VALVES NO FLOATS

Self-Priming Centrifugal Pumps

Write for Bulletin

THE LABOUR CO., INC. 909 STERLING AVE. ELKHART, IND.

. . . the BRIDGE BUILDER'S MIXER



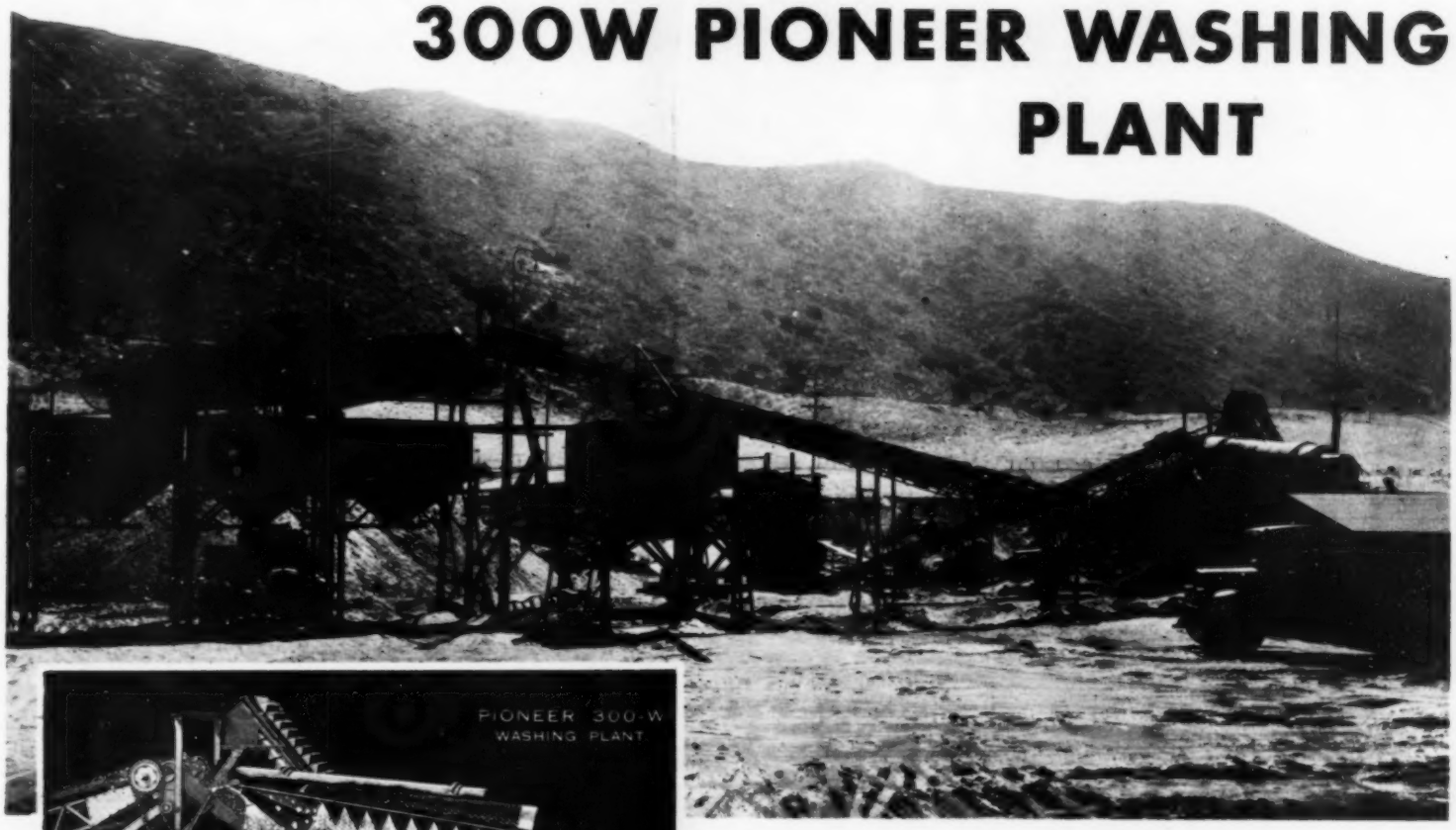
JAEGER 10-S with ACCURATE WATER REGULATOR Cuts Your Job Cost—Bridge contractors everywhere are using this faster, easier handling 2-bagger to get more production, push their crews and reduce costs. Improved positive syphon type Water Regulator meets most rigid state specifications. Get our low price. The JAEGER MACHINE Company, 800 Dublin Ave., Columbus, Ohio.

$180 f. o. b. Columbus buys Jaeger **10,000** GAL SURE PRIME PUMP Write us

AGGREGATES FOR EL CAPITAN DAM

Produced By

300W PIONEER WASHING PLANT



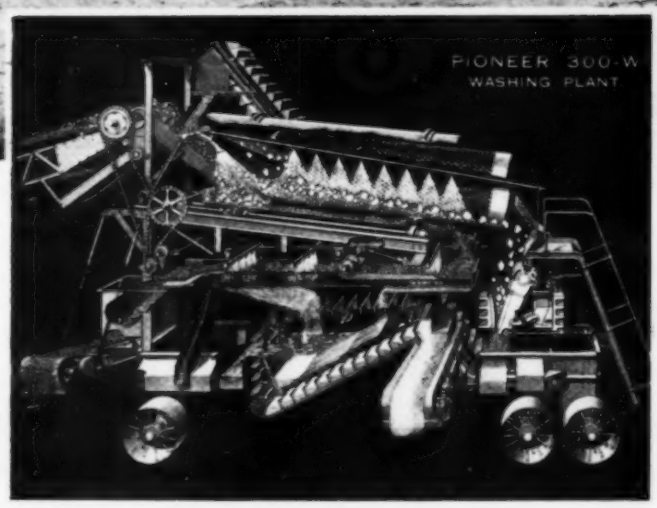


Diagram of 300W Pioneer Washing Plant, showing the course of material through the plant.

Close-up view of 300W Pioneer Washing Plant, owned by Rohl-Connolly Co. and located at Lakeside, which is furnishing washed aggregates for El Capitan Dam.

The Pioneer Feeder Conveyor delivers material from the Pioneer Primary Breaker to the Pioneer 300W Washing Plant at rhe right, where it is washed and screened, the oversize going to the secondary crusher to be recrushed and returned by bucket elevator to the revolving screen for rewashing. The sand is passed to the dehydrator, hence to the sand bins by sand delivery conveyor. The aggregates are conveyed to the Pioneer Revolving Screen mounted above three 21 yd. Pioneer portable bins which separate the three sizes of aggregate.

For large or small jobs, there is a portable Pioneer plant, built to produce required capacities of low-cost specifications aggregates. The economy of Pioneer plants is in their ability to stand up under difficult conditions and "deliver the goods." This is because practical gravel men with years of experience know how to build.

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GRAVEL EQUIPMENT

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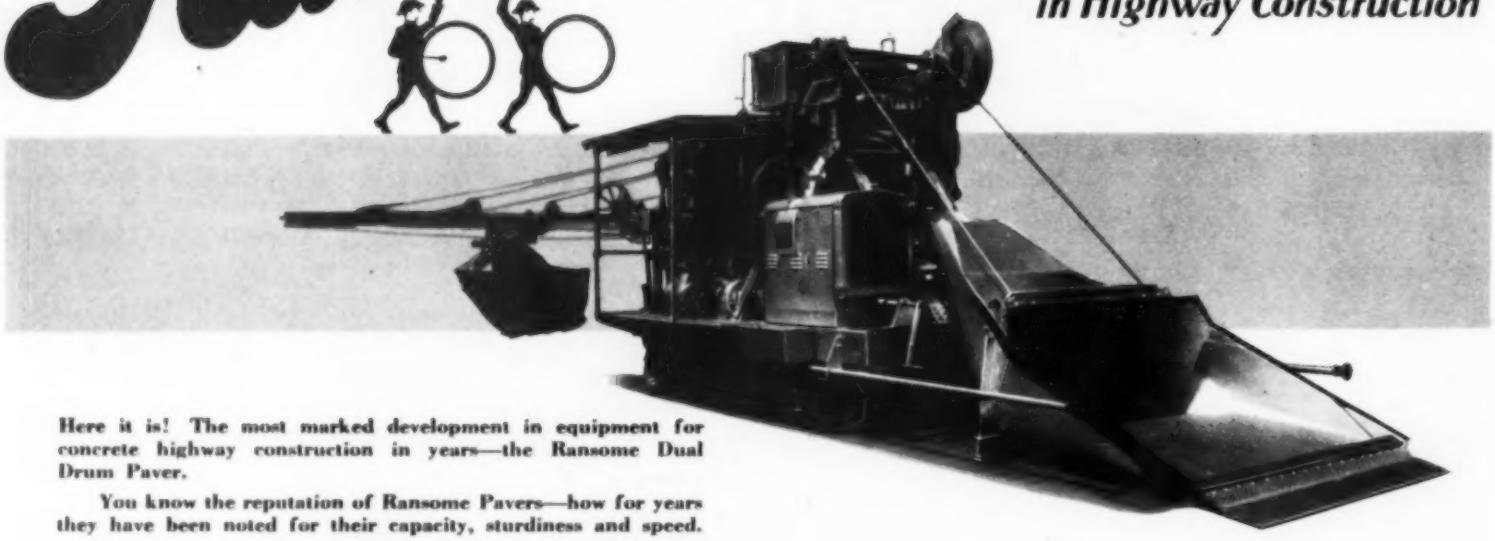
PIONEER GRAVEL EQUIPMENT MFG. CO.

1515 CENTRAL AVE. MINNEAPOLIS, MINNESOTA

the Ransome Dual Drum PAVER
"LEADS the PARADE"
in Highway Construction



Here it is! The most marked development in equipment for concrete highway construction in years—the Ransome Dual Drum Paver.

You know the reputation of Ransome Pavers—how for years they have been noted for their capacity, sturdiness and speed.

Now Ransome offers the Dual Drum Paver as the most modern tool of this "reconstruction era". Actual performance tests in concrete highway construction this spring have shown the Dual Drum Paver far ahead in production—from 50% to 66 2/3%—of any standard 27-E-Paver yet built. From New England where the first dual drum was operated, the news of this unusual paver has spread rapidly. Contractors and engineers have checked its large daily output and economical operation and have said "O. K.".

Before you buy a road paver, study the merits of this speedy rugged Ransome Dual Drum Paver.

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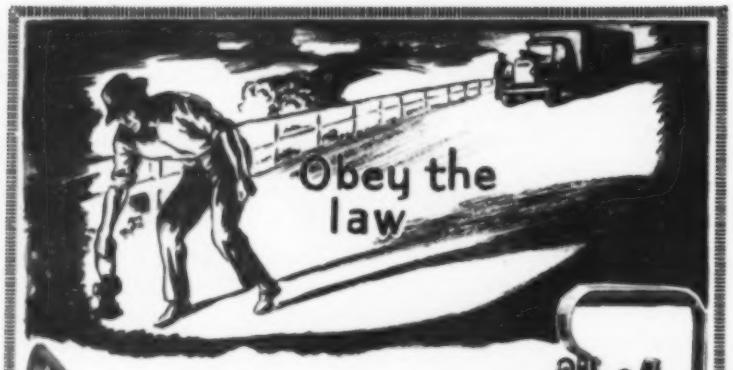
Ransome Concrete Machinery Co.

1853 – Service for 80 Years – 1933

Dunellen **New Jersey**



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Lights a stalled truck and shows a red light to warn oncoming traffic

Place one of these Lanterns the required distance from the truck, on each side. Each lantern has *a red safety lens* in the rear. You get perfect two-way protection. This is only one example of the many kinds of service these sturdy, simple lanterns give. Lamp holds enough National Carbide and water for 8 hours continuous lighting.

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Manufacturers of National Carbide "In the Red Drum"

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9 TYPES AND SIZES

⅜-yd.—Part Circle or Full Circle
½-yd.—Standard or Heavy Full Circle
¾-yd.—Standard or Heavy Duty
1-yd.— " " " "
1¼-yd.—Standard 3 to 18 Ton Cranes

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IN with the new OUT with the old

NEW STANDARDS AND MODERN METHODS FOR THE NEW DEAL

National Recovery is geared to new principles. Wider stretching of highway budgets — greater returns for taxpayers' money — quicker opening to traffic of new paving . . . these demand the most economical, positive, durable and speedy method of curing concrete.

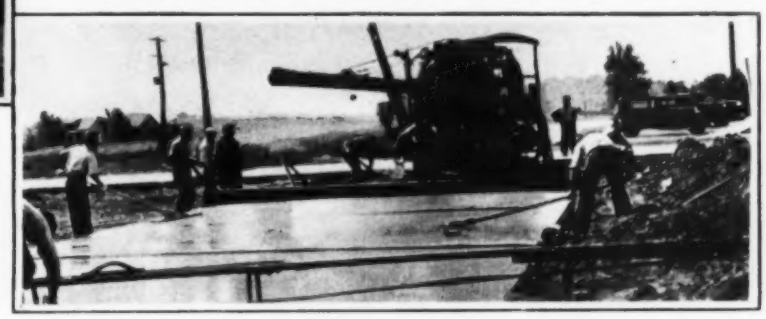
CURING concrete with Calcium Chloride is an advance in line with the modern design and construction of pavements. Over the entire country engineers in charge of the development of large highway programs have adopted the use of Calcium Chloride for curing. Thousands of miles of smooth, durable pavements constructed over a period of ten years prove the efficiency of Calcium Chloride for curing.

Calcium Chloride cures more uniformly and thoroughly than is possible with the old methods of ponding, earth, or straw covering. Either applied on the surface or incorporated in the concrete mix, Calcium Chloride curing is both economical and efficient. It eliminates the necessity of keeping roads closed for long periods and reduces the expense incurred by the traveling public due to the use of detours as caused by the lengthy and older methods of curing. No longer is it necessary to incur expense of hauling, spreading, continual wetting and removal of cover material.

Send — today — for descriptive literature and other details about curing concrete with Calcium Chloride. Address any of the undersigned members of this Association.

↑ **ON THE SURFACE**—*Surface curing with Calcium Chloride is very simple. The Calcium Chloride insures a continuous supply of moisture for curing the concrete—no further attention being required. Calcium Chloride may be spread on the surface of the concrete the first operation in the morning following the placing of the concrete.*

↓ **IN THE MIXER**—*Calcium Chloride incorporated in the concrete mix not only insures proper curing of the concrete, but accelerates the curing and provides high early strength in the concrete. This added advantage of being able to open pavements at the earliest possible time is secured by this method of curing without added cost. A solution prepared on the job can easily be placed in the mixer drum at the time of mixing.*



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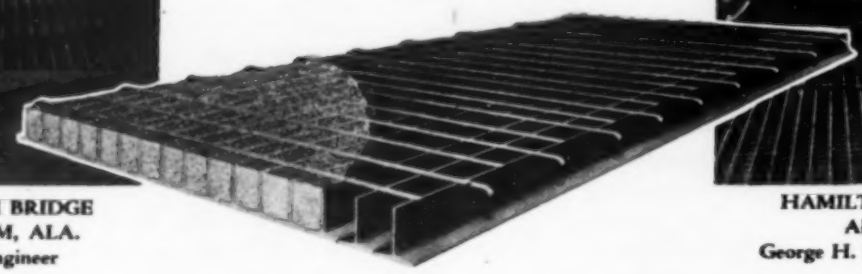
A widely endorsed bridge floor construction of great rigidity, extra strength, minimum dead weight and uniform load distribution providing a steel-armored wearing surface and erected rapidly without concrete forms. Cross bars are pressure welded to tees with no reduction of area—triangular bars hold concrete positively in place—girders, stringers and Teegrid slab become a homogeneous steel diaphragm to resist distortion stresses.

Write for the Teegrid Handbook



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Flow of material controlled by a direct Single Valve. It's as easy to operate as a single dial radio.

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Complete information and prices sent on request.

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HERE IS THE DATA YOU NEED
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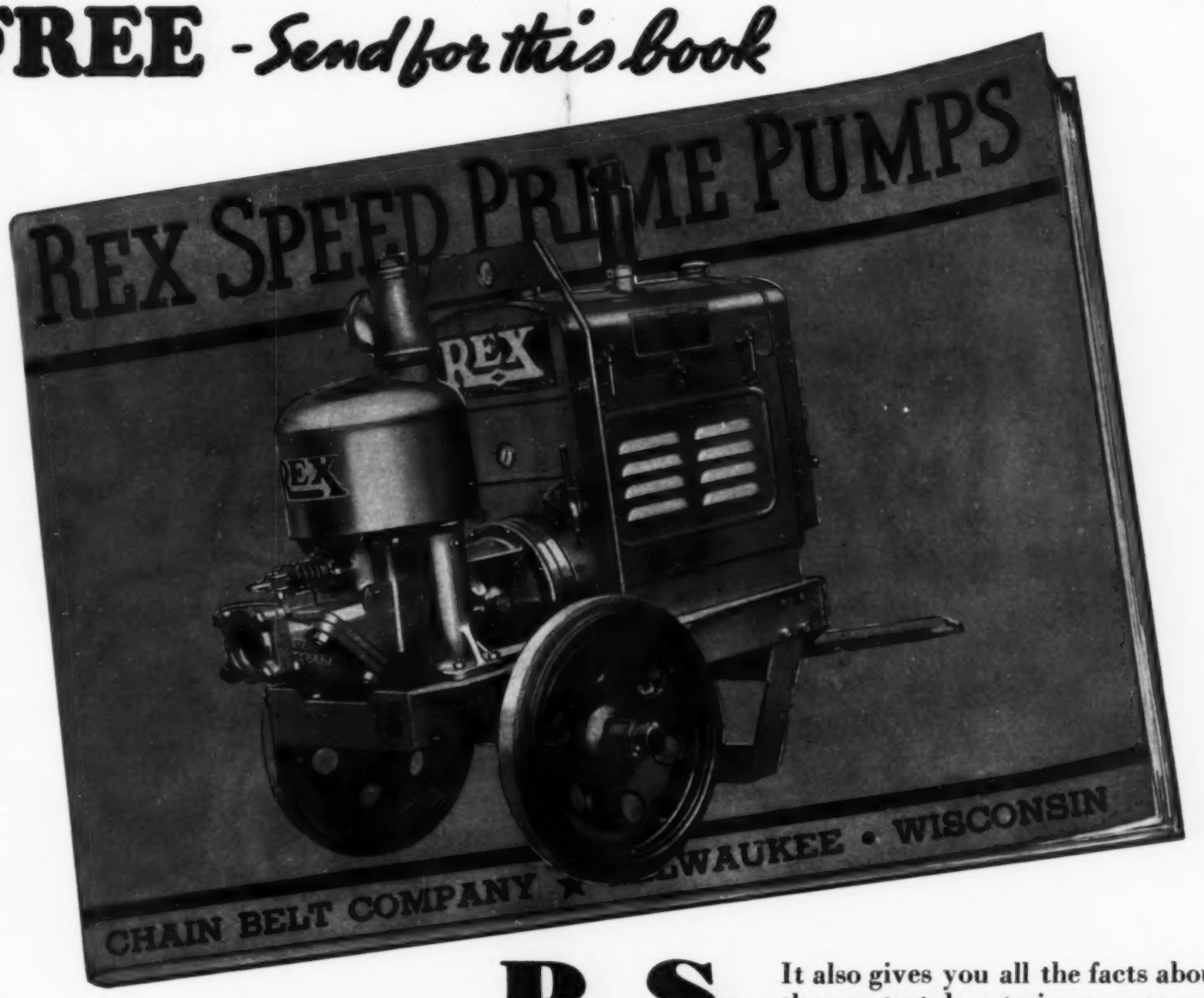

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EVERY contractor will want this book and want to keep it. It reduces pump application to simple arithmetic. With it you can figure just the pump you need on any dewatering job . . . Shows you just how to figure lifts, heads and capacities. Then all you'll have to do is turn back and pick the Rex Speed Prime Pump that gives you the capacity you need—and shoot . . . You'll have a pump that will do its job—at lowest cost for pumps and power. Send for your copy today. Ask for the book "Rex Speed Prime Pumps."

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TRUKMIXERS

Blaw-Knox TRUKMIXERS are particularly suited for contractors who plan to use the truck mixer method for highway work and general concrete construction.

With the truck mixer method the contractor can arrange his costs to get the jobs he either has been losing or has not cared to figure on.

The increasing construction business coming your way can be taken at a profitable figure when you have Blaw-Knox TRUKMIXERS to handle it.

Buy the Blaw-Knox TRUKMIXER—it is made in all sizes.

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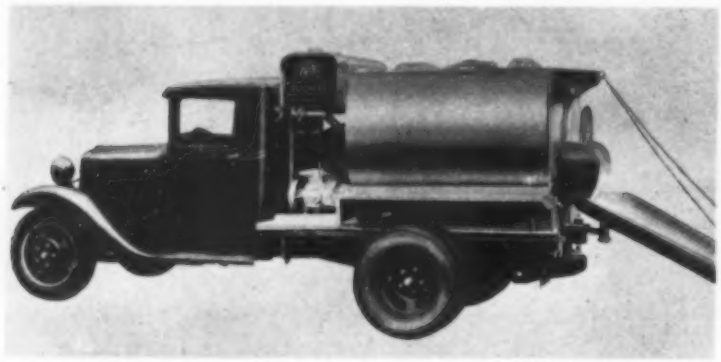
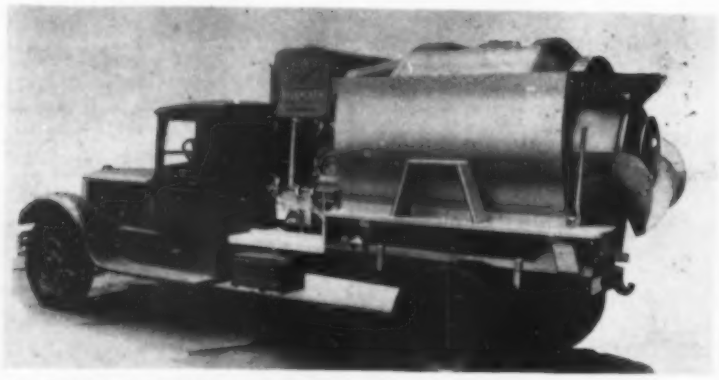


1 Cu. Yd.

2 Cu. Yd.



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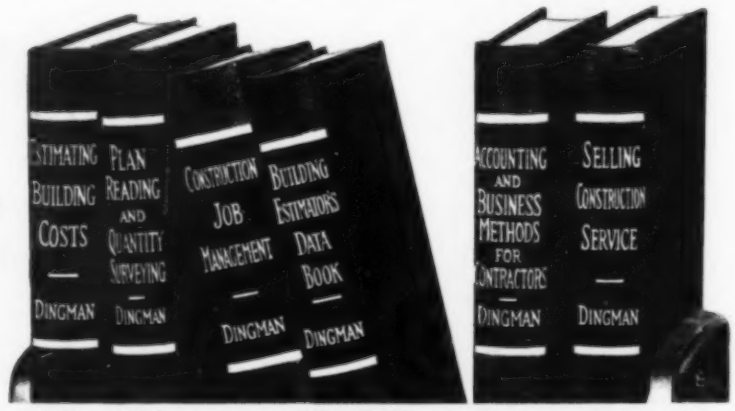

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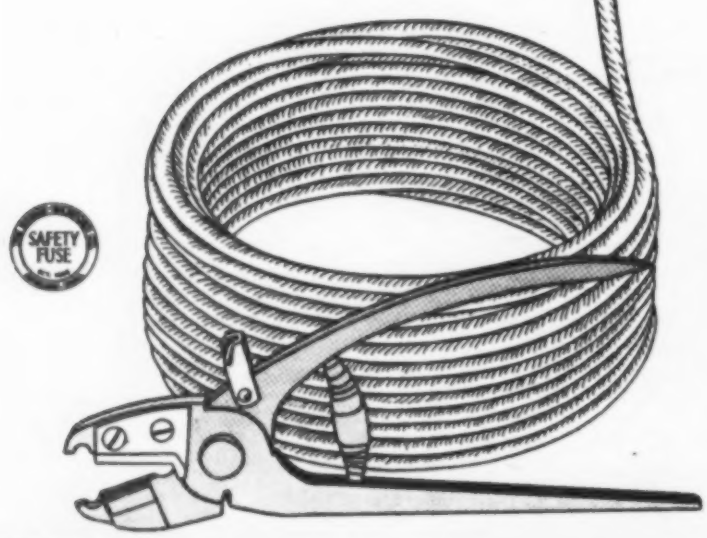

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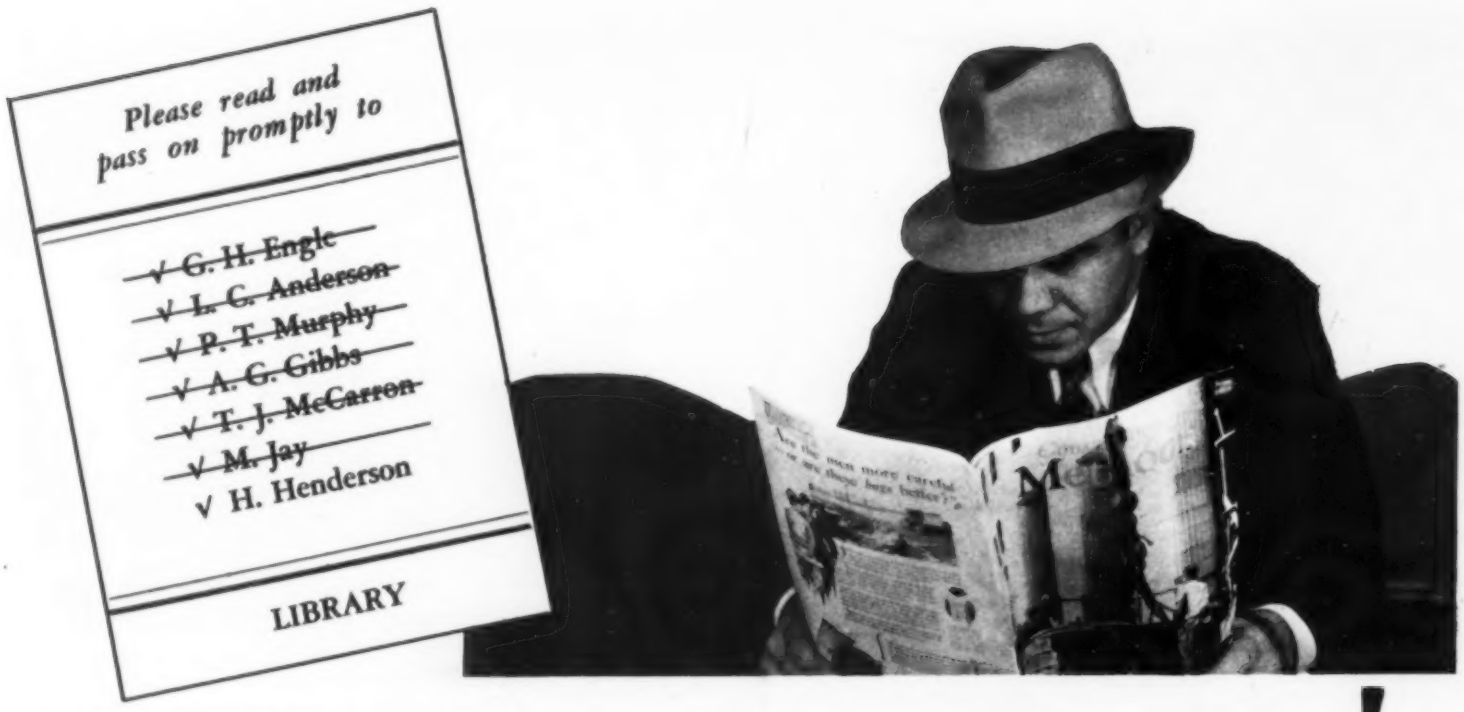

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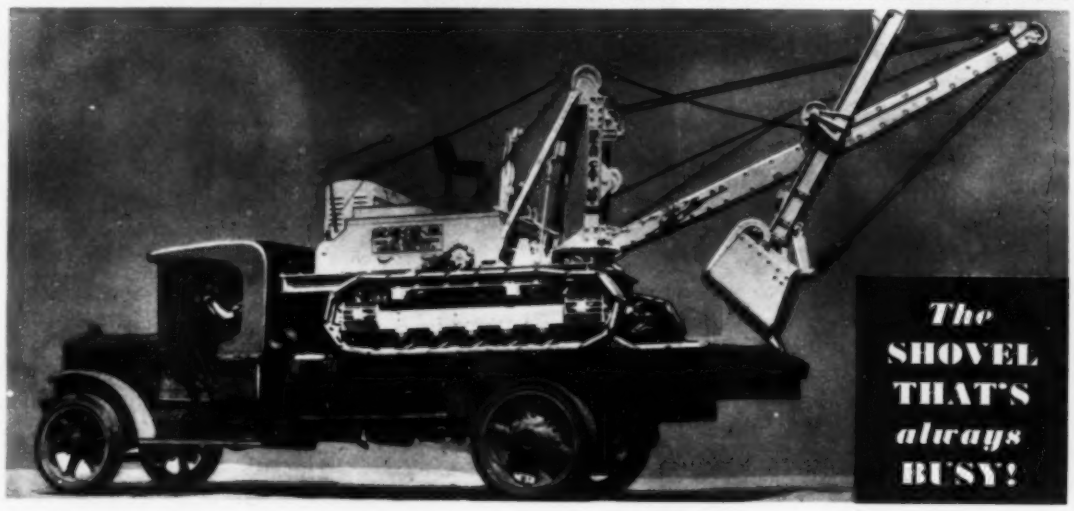

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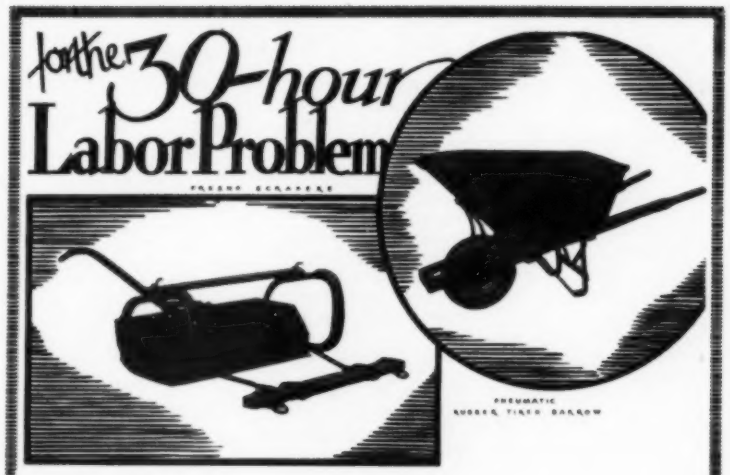

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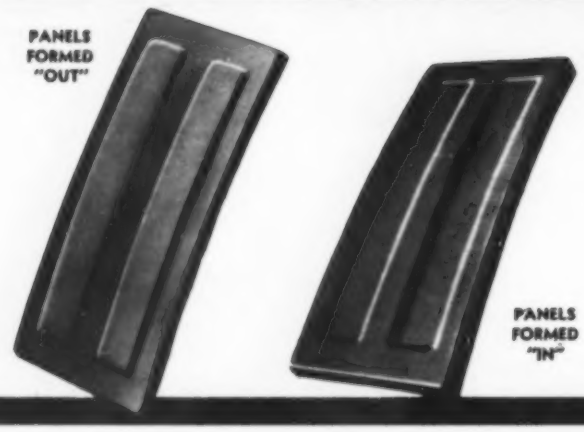

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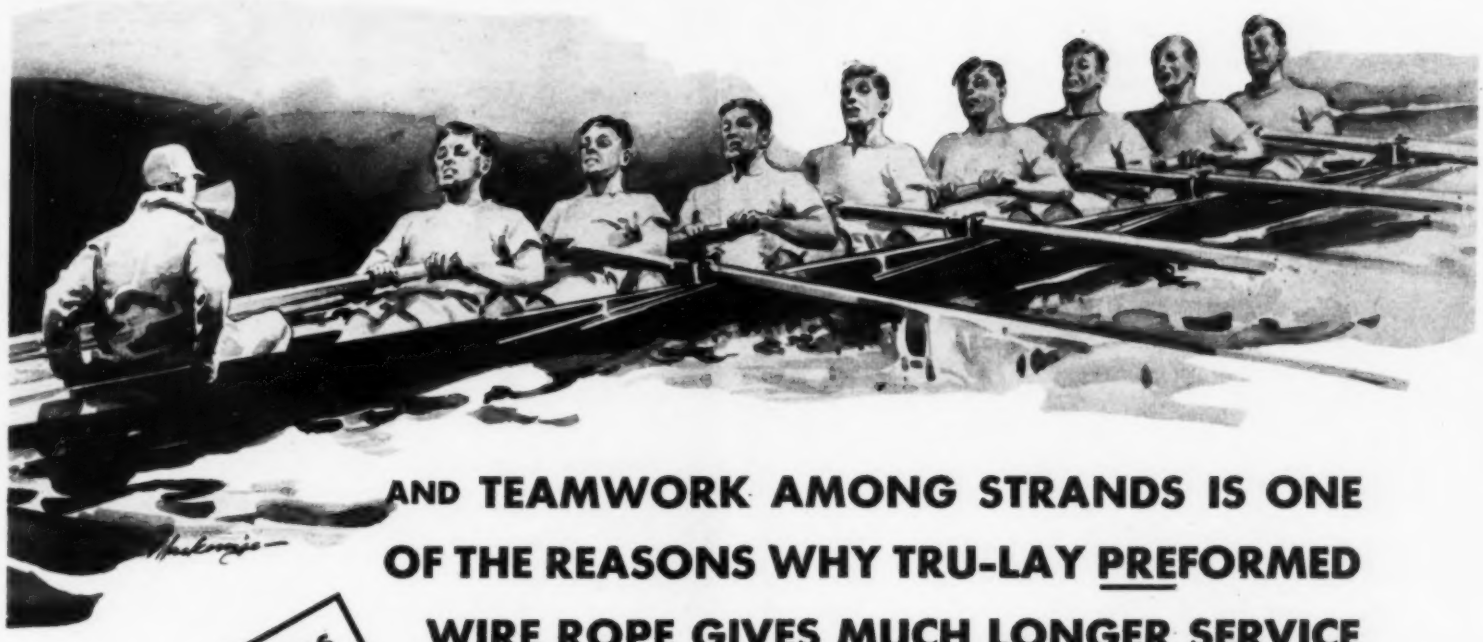

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